WBS 3.0, C-0 Outfitting
of the
BTeV Project
Sub-Project Execution Plan
March 2004

Fermilab

Fermi National Accelerator Laboratory
A Department of Energy National Laboratory
Managed by Universities Research Association

FESS/Engineering Project No. 6-8-3

The Project Execution Plan (PEP) describes the management, control systems and procedures used by Fermi National Accelerator Laboratory (Fermilab) to meet the technical, cost, and schedule objectives of the conventional construction for this project. This controlling document establishes the basis against which progress will be measured.

This project will be managed based on the guidance provided in DOE Manual 413.3-1. This manual is not the sole source for all requirements and guidance that apply to the acquisition of capital assets. Other DOE Order and Manuals, especially regarding design, engineering, management reserve and indirect costs have been used to determine the basis for estimating costs and establishing baselines. This identification, implementation and compliance with other relevant Orders, Manuals and requirements is the responsibility of the Integrated Project Team.

The PEP is to be viewed as a “living document,” and as such, will be revised when necessary. The Project Manager is authorized to approve non-substantive changes to the PEP (e.g. name changes to the positions sited in the PEP), but will inform the DOE Project Manager via e-mail of such changes. Baseline changes will require approval by the Department of Energy’s (DOE) Fermi Area Office.

SUBMITTAL PAGE **C-0 Outfitting**

Submitted, Accepted, and Approved By:

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PROJECT OBJECTIVES C-0 Outfitting

The physics and technical objectives for the BTeV project are described in the overall BTeV Project Execution Plan (PEP). This document is meant to augment the project's PEP with the applicable DOE and Fermilab requirements for WBS 3.0 C-0 Outfitting. General requirements such as progress reporting and change control between level two sub-projects will conform to the BTeV project's PEP in addition to applicable portions of this document.

The objective of the C-0 Outfitting is to construct the scope to support the BTeV project, for the cost presented within this document, meeting the schedule milestones agreed to for the overall project. As with all projects, accomplishing these tasks in a safe manner to the environment, to all workers and the end users is a priority.

PROJECT SCOPE **C-0 Outfitting**

The C-0 Outfitting site work involves upgrades of the existing C-0 Test Area Building constructed in 1998 to install the power and mechanical services required to support the BTeV project. Upgrades to the site area includes the construction of mechanical equipment and Dewar support pads, a shed type building for gas bottles, underground utility work for and a new 13.8 KV feeder duct bank from the existing manhole at the B-4 Service Building to a new transformer pad at the C-0 Building. The transformer pad will contain three new 1500 KVA transformers, 13.8 kv switchgear and a 250 KVA Diesel Generator. Included in the site electrical work will be the construction of a new bus duct enclosure from the C-0 Service Building to the Collision Hall. Also included is the installation of a new 1500 KVA transformer at the C-0 Service building and new 500 KVA transformers at service buildings B-4 and C-1.

The architectural build out portion of this project consists primarily of the installation of walls, doors, finishes, stairs, elevator, and raised computer flooring. Once the concrete floors have been installed to provide new floor levels at elevations 755'-4" and 764'-2", concrete block walls will be constructed between the high bay area and each of the newly installed floor sections on the north side of the building. Two of the 3 floors will have windows installed between the newly occupied space and the existing high bay. These windows will allow in daylight from the existing high bay skylights to enter the new areas, thereby enhancing the quality of the spaces, and allowing occupants to view the activities below.

Concrete block walls and hollow metal doors will be installed to enclose the equipment room, the elevator shaft, the stairway, the toilet rooms and janitor closets, as well as the mechanical and equipment rooms at elevations 731'-4" and 715'-0". An elevator will be installed in the existing previously planned shaft space. The elevator will be a 5,000-pound capacity "hospital" type elevator with openings on either end as required to accommodate the floor plan, with a total of 5 stops. Slight modifications will be made to the roof above the elevator shaft, raising it to a height that will provide the required head clearance for the elevator access to the third floor. An enclosed stair will be construction on the north side of the building, to provide the code required second means of egress for the first, second and third floors. It will consist of steel framing with siding and roofing to match the existing building. The current stairways provide the required exits from below grade spaces.

The entrance level (first floor) of the building (elev 746'-6") will have a raised computer floor system installed over the already constructed depressed floor. Also constructed on this floor will be the interior stairs, the stair enclosure and the wall for the electrical equipment room and elevator enclosure, as well as the wall separating this floor from the high bay. Similar to the first floor, the second floor

of the building (elev 755'-4") will see the construction of the interior stairs, the stair enclosure walls, and the wall closing off this floor from the high bay. In addition, this floor will house the new single user men's and women's toilet rooms, the janitor closet and a small kitchenette to service the building occupants. The third floor (elev 766'-0") will have a raised computer floor system installed over the newly installed concrete floor construction. Constructed on this floor will be the interior stairs, the stair enclosure wall, the elevator enclosure walls, and the wall separating this floor from the high bay.

Finishes

The wall finishes will consist of painted concrete block for the new block walls. The ceiling finish will consist of the exposed underside of the concrete deck, painted with a textured, acoustical material to improve the acoustical qualities of the room. The interior liner panel of the exterior siding will provide wall finishes along the exterior walls. The second floor will have carpeting. The first and third floor computer rooms will have stringer type computer flooring. The computer floors will be isolated to building ground and have a separate under floor ground grid tied to the primary transformer-grounding loop. The toilet rooms, janitor closet and kitchenette will have ceramic tile floors. All other areas (corridors, stairs, mechanical and equipment rooms) will have sealed exposed concrete floors.

Structural

The new floor levels at elevations 755'-4" and 764'-2" will be eight-inch thick post tensioned, prestressed concrete floor slabs that have been selected to provide a minimum floor thickness. The slab will simple span between steel beams framed into the existing steel columns. Final design will evaluate cost and construction benefits of the precast slab system vs. a cast-in-place post tension flat plate floor system.

Conventional Mechanical (HVAC)

The 3rd floor will be outfitted with 4 (CRAC) Computer Room Air Handlers to handle approximately 342 KW to 350 KW heat load from high density computer racks, or 44 computer racks with heat density of approximately 7.8 to 7.9 KW per rack. Each CRAC will be discharging approximately 52 to 56 F supply air into a common underfloor supply plenum. There will be no spare or backup CRAC unit. Each unit will have leak detection sensor. All unit and leak sensors will tie in to a central monitoring panel. The CRAC humidifier system will be plumbed to domestic water to maintain the 45% +- 5 RH at all times. Each CRAC will have corresponding outdoor air-cooled condenser with R22 refrigerant. The

raised floor air distribution system plenum height is tentatively set at 1'-10", and may be optimized during design stage. The layout of the racks will utilize the "hot-aisle cold-aisle" concept commonly used in present day high-density data center. Due to lack of ceiling height, there will be no common return plenum. The rack dimension given is based on Wide Band HDCF Project at 3 ft x 2 ft x 6.5 ft height. The placement of this equipment in relation to the CRAC is very critical in ensuring optimum air distribution therefore the floor layout may be final altered during design stage. The space condition is at 72 F dry bulb and 45%RH, and designed with no occupant heat load during standard operation. The space to be occupied by the underfloor cabling is not yet defined but based on preliminary information it is noted that it will occupy minimal space and is assumed to be no more than 20% of the underfloor space. The air supply floor grille will be selected to have higher throw, more free area and less pressure drop to optimize the air distribution.

The 2nd floor office area will be served by a dedicated air-handling unit (AHU) with chilled water coil and electric heating coil. The unit will be located in the mechanical room. Air from AHU (estimated at 5 ton) will be distributed to this area via an insulated ductwork system to be routed to the office area through the pipe/duct chase. This unit will utilize an economizer cycle to cool the space when outdoor air temperatures are appropriate. Minimum outdoor air for 25 persons will be included in the air handling unit design. The space condition is for a typical office space (75 F & 50%RH for cooling, and 68F for heating).

The 1st floor computer area (~132KW or 38 Ton) will be served by a closed loop 55F "electronic cooling water system" (ECW). Except for the ECW header inside the room and the chilled water service to the heat exchanger, the rest of the ECW system, which includes plate heat exchanger, pumps, strainer, UV system, and controls is currently not part of this WBS 3.0, C-0 Outfitting scope. System piping shall be insulated copper. A supplemental computer air handler with no backup, will serve this floor.

The Collision Hall will be served by a dedicated air-handler (estimated at 20 Ton or 8,000 cfm). This air-handler includes chilled water coil, heating coil, and humidifier system to meet the space requirements. There will be two modes of operation, HVAC-normal mode and ODH-purge mode. The cfm requirement for ODH-purge mode is 5,000 cfm. There will be a combination purge fan / return fan that will handle air from the collision hall. The heater coil will be sized to keep supply air above freezing to preclude bursting of the inside piping during ODH mode condition during winter. Redundant HVAC and fan are NOT required, however fans and heaters, required for ODH purge operation will be connected to the generator. The collision hall requires space temperature of 60F to 80F at

40%RH to 50% relative humidity, except during purge mode. The unit will maintain air dewpoint to 53F, except during purge mode. The Collision Hall space requires a continuous constant make up air for inert gas purges, of no less than 50 cfm. Make up air requirement based on ASHRAE will also be included. This will be served by a dedicated outdoor make up air. The ODH airflow requirement is 5000 cfm.

The Assembly Hall will be served by a dedicated air handler (estimated at 20-Ton/8,000 cfm) with chilled water coil, and heating coil system to meet the space requirements. There will be two modes of operation, HVAC-normal mode and ODH-purge mode. Where applicable, the unit will utilize an economizer cycle to provide free cooling when outdoor air temperature is appropriate. There will be a combination purge fan / return fan that will handle air from the assembly hall. The heater coil will be sized to keep supply air above freezing preclude bursting the inside piping during ODH mode condition during winter. Redundant HVAC and fan, and backup power to this unit are NOT required. The Collision Hall requires space temperature of 60F to 80F at 40%RH to 50% relative humidity, except during purge mode. The Assembly Hall space requires a continuous constant make up air for inert gas purges, of no less than 50 cfm. Make up air requirement based on ASHRAE will also be included. This will be served by a dedicated outdoor make up air unit. The ODH airflow requirement is 5000 cfm.

The electronic bridge area will be served with two DX split AC unit. Estimated load given from racks is 2 KW.

There will be one outdoor air-cooled water chiller (no backup), preliminary estimate at 120 ton each, which will provide 45 F glycol-chilled water to the air handlers, make-up air unit and the heat exchanger.

The air handlers, make up air unit, chiller and pump in the mechanical room will be outfitted and will be integrated with site DDC controls building automation system. The building HVAC system will be provided with basic controls and monitoring using DDC (Direct Digital Control) compatible with site wide BAS. The chiller and chilled water loop will be provided with taps and minimum flow, temperature and flow sensors for monitoring purposes and alarm and for future connection to experiments slow process controls. The chiller and pumps are self-controlled and will be started and switched manually. The chiller will have multiple compressors and built in staging controls. Chilled water pump shall be manually started and switched. The 3rd floor High-density computer rack cooling system will be monitored only using Metasys DDC. The Assembly Hall and Collision Hall air system, and ODH purge system will be provided with basic HVAC control compatible with site wide BAS. Additional sensors and industrial

type controls that may be required specific to the experiments will be design and selected by the experimenter/user and commissioning will be coordinated as required. Other sensors and controls as mandated by ASHRAE 90, where applicable to the building system, will be provided
Electrical Room and elevator shaft will not require any HVAC.
Applicable requirement from ASHRAE 90.1 (such as economizer, C02 sensors, ventilation controls) will be incorporated.
Heating. Air handler will be provided with electric heating coil. The high bay will make use of the existing electric space heater.

Building plumbing.

Condensate drains will be provided for the 1st floor and 3rd floor-cooling unit. The mechanical floor will be rework to include floor drains. Building plumbing will be sized and designed in accordance with Illinois Plumbing Code.

Fire Protection / Fire Detection

The fire protection systems will comply with the criteria set forth in the National Fire Protection Association pamphlets and National Building Code. In particular, the pamphlets referenced are as follows:

NFPA 10 – Standard for Portable Fire Extinguishers
NFPA 13 – Standard for the Installation of Sprinkler Systems
NFPA 15 – Standard for Water Spray Fixed Systems for Fire Protection
NFPA 70 – National Electrical Code
NFPA 72 – National Fire Alarm Code
NFPA 90A - Standard for the Installation of Air-Conditioning & Ventilating
NFPA 2001 - Standard on Clean Agent Fire Extinguishing Systems

Currently the existing C-0 Collision Hall has a complete addressable fire alarm system monitoring the entire facility and can be extended to monitor the new fire alarm points. In addition, an existing FIRUS system is installed which signals any fire alarm to our on-site Communications Center, so that emergency personnel can be dispatched.

A description of the fire protection system is as follows:

Collision Hall
Provide a pre-action fire sprinkler system connected to the existing piping network. This system will be designed to provide a minimum of 0.20 gpm per square foot over the most remote 1,950 square feet of sprinkler operation. The

pre-action valve will introduce water into the piping network upon loss of air and smoke from an air sampling smoke detection system.

Assembly Hall
Connect with a new sprinkler riser to the existing overhead wet-type fire sprinkler system. This system is designed to provide a minimum of 0.20 gpm per square foot over the most remote 1,500 square feet of sprinkler operation.

Mechanical Rooms
Provide a new wet-type fire sprinkler system utilizing quick response sprinklers, designed to a minimum of 0.15 gpm per square foot over the most remote 950 square feet of sprinkler operation.

Computer/Mezzanine Levels
Provide a new wet-type fire sprinkler system utilizing quick response sprinklers, designed to a minimum of 0.15 gpm square foot over the most remote 950 square feet of sprinkler operation. In addition, a clean agent fire extinguishing system activated by high velocity smoke detection, will be provided to protect the raised computer floors and monitored by an auxiliary releasing fire alarm control panel.

Gas Shed
Provide (IF NECESSARY) a fixed water spray system protecting the gaseous tanks.

Electrical
The primary power transformers will be fed from a new 13.8kv feeder routed through spare ducts in the Main Ring duct bank to a breaker at the Kautz Road Substation (KRS). In addition, feeder 45 will be routed to the primary transformers from an open bay at the B-4 Service Building air switch. Feeder 45 will allow approximately 2 megawatts of available power prior to the installation of the new dedicated feeder for equipment power testing and building house power and allow for feeder maintenance of the new feeder. Both feeders will terminate at an air switch located on the primary transformer pad. A Kirk key system will be provided. One 1500 KVA transformer is dedicated to the detector's magnet and other equipment operated by power supplies. One 1500 KVA transformer will supply quiet power for electronics and computers. A 1500KVA transformer will supply house power. Critical safety systems will be on a 250 KVA generator with automatic transfer switch. User power will terminate at disconnect switches or circuited panel boards in computer rooms. Because of the structural systems planned and the existing constraints, all conduits will be surface mounted.

C-0 Service Building Upgrade

The C-0 Service Building Upgrade provides for the architectural and HVAC modifications and electrical power additions to support the Low Beta System at C-0. The existing service building consists of office space, shops and data rooms. The current office/tech space will accommodate new power supplies for the Low Beta System. HVAC modifications include the addition of exhaust fans and exterior wall louvers to cool the power supply room. A new 1500KVA transformer will be installed outside the C-0 Service Building to support the Low Beta System. The transformer will be connected to the power supplies by underground duct bank through the exterior wall of the service building. The transformer shall be fed from the existing pulse power feeder 23 located in the Main Ring Road duct bank. A new 2000Amp switchboard will be installed. Also fed from feeder 23 are new 500 KVA transformers at Service Buildings B-4 and C-1 that will feed 1200 AMP switchboards. Air switches will be installed to transition from 750 MCM to 350 MCM cable. Other than the power upgrades at B-4 and C-1, no other work in the buildings is anticipated as part of WBS 3.0.

DOE Management

The Department of Energy provides funding for this project through the Fermilab annual budget process. The Manager of the Chicago Field Office (CH) has been delegated the authority and responsibility for field oversight of the project. This includes line management authority, responsibility and accountability for overall project implementation and contract administration. Specific responsibilities of CH include support to the Fermi Area Office in the following areas:

- Quality Assurance
- Implementation of ES&H
- Project Management Systems
- Design Review
- Legal

The Fermi Area Office administers the M&O contract with URA for operations of Fermilab and exercises oversight of Fermilab. The Fermi Area Office Manager, Ms. Jane Monhart, has been delegated responsibility and authority for execution of the project. The specific responsibilities of the Fermi Area Office manager are:

- Supervision of DOE Project Manager and Fermi Area Office staff
- Review of and concurrence with this PEP
- Review and approval of documents as required by federal regulations or departmental orders or notices
- Approval of Fermilab subcontract actions, within the authority delegated to Fermi Area Office
- Financial management functions as delegated by CH

Funds will be made available to DOE for the project on an annual basis following passage of legislation in the U.S. Congress. The Fermi Area Office will make funds available to Fermilab for the project based on the existing directive system.

The Fermi Area Office Manager has delegated authority and responsibility for management and direction of the project to the DOE Project Director. The specific responsibilities of the DOE Project Director include:
Review and approval of this PEP and changes thereto

- Measurement of performance against established goals including technical performance, cost levels, and schedule milestones
- Making any necessary changes or corrective actions within the appropriate thresholds established in this PEP
- Overseeing Fermilab’s management of construction activities

- Monitoring project progress via reports prepared by the Project Director
- Controlling the project contingency funds and authorizing its use within the levels established within this PEP
- Coordinating the approval by the Fermi Area Office Manager, the construction project directives and modifications thereto

The DOE has delegated the responsibility for design and construction of this project to Fermilab.

Fermilab Management

The project management team structure shown in Figure 1 identifies the organizational structure that will be responsible for design, procurement and construction of WBS 3.0 for the project.

As with all activities at Fermilab, the Directorate is at the highest level of responsibility.

Fermilab through Particle Physics Division (PPD) has designated Mr. Joel Butler and Mr. Sheldon Stone as Project Director and Deputy Project Director, respectively. The details of the WBS 3.0 C-0 Outfitting Project Management responsibilities have been identified in the Responsibilities Matrix contained in the appendix of this document.

Design, construction management, cost and schedule for the C-0 Outfitting portion of this project are the responsibility of the Facilities Engineering Services Section (FESS). FESS, headed by David Nevin, will manage the engineering and civil construction associated with this project, as well as accept line management responsibility for safety. This effort will be accomplished using the resources of the FESS Engineering Group, led by manager Ed Crumpley. The Engineering Manager shall assure proper attention to the coordination and timely completion of the project.

Tom Lackowski, of FESS/Engineering, will serve as Project Engineer and Construction Manager for this project. The Project Engineer/Construction Manager will utilize the resources of the Engineering Group as appropriate for design, construction phase support, and construction coordination. Portions of the civil design may be subcontracted to an Architectural/Engineering firm. A summary of the Project Engineer/Construction Manager functions and responsibilities is provided in the attached responsibilities matrix.

Mr. Emil Huedem has been assigned as Task Coordinator for this project. The Task Coordinator will handle coordination of design team efforts. A summary of the Task Coordinator functions and responsibilities is provided in the attached responsibilities matrix.

The Business Services Section (BSS), headed by Dave Carlson, has the responsibility for contract administration, providing budget status and subcontract/requisition information. The details of the Procurement Administrator's responsibilities have been identified in the Responsibilities Matrix contained the appendix of this document.

ES&H Management

The ES&H Section, headed by Bill Griffing, with Mary Logue as Associate Head of the Health & Safety Group, has the responsibility for providing safety coordination support and oversight of safety throughout the project. As with all Fermilab projects, attention to ES&H concerns will be part of project management and safety will be incorporated into all processes. Line management for safety on this project will be the responsibility of the Particle Physics Division (PPD). Although line management will be the responsibility of PPD it is understood that for the work that is within the geographical boundaries of the Accelerator Division (AD) the AD rules and guidelines will be followed. In addition all work notification and excavation permits will obtain the approval of the AD Senior Safety Officer.

The ability to perform the construction work safely will be designed into the project. Construction documents (drawings and specifications) will be reviewed as the documents are developed, by Fermilab engineering, construction, and safety professionals to ensure ES&H concerns are addressed. Project specific safety and health requirements for construction will be outlined in the construction documents.

Job coordination during construction will be accomplished through the Fermilab Construction Coordinator (FCC), a member of FESS/Engineering, who shall be responsible for daily monitoring of all work at the site, including the ES&H program. The Construction Manager shall be the first line of contact with the Construction Subcontractor's organization. The FCC reports to the Construction Manager for this project. The Subcontractors will be pre-qualified for bidding by submitting specific information about their safety and health program with the bids. During construction the Subcontractors will use Project Hazard Analyzes (PHA) to plan the work and mitigate hazards. The FCC will

audit the Subcontractor's compliance with the PHA's and with their overall Safety Plan. The Fermilab ES&H Section will support the FCC with safety personnel during construction.

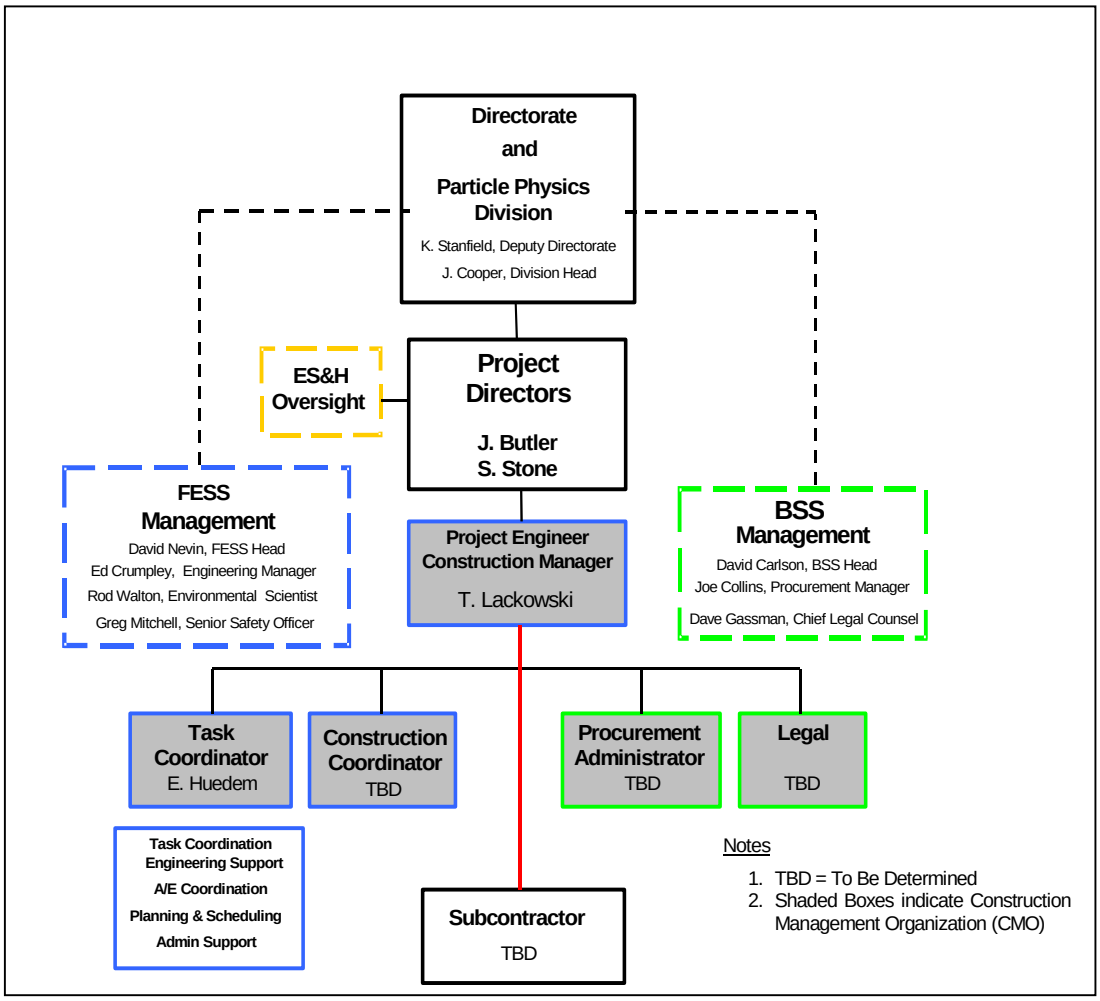

Figure 1 –Organizational Chart

Funding

This portion of the BTeV project has a burdened Estimated Cost (TEC) for WBS 3.0 of $7,176,914 including construction costs, EDIA, contingency, management reserve, and indirect costs. Escalation costs are held and accounted for in the Project Management portion of the project.

Personnel

Divisions and sections will be responsible for assigning the responsibilities of individuals within the design and construction organization as indicated in Figure 1 of Section C. In addition, Fermilab will provide the personnel required to adequately review and oversee design and construction phases.

Design reviews will occur at varying levels throughout Title II. All Divisions and Sections are aware of the design review process and will assign appropriate personnel to complete the reviews for conformance and compliance.

Divisions and Sections will provide required personnel to coordinate construction phase activities that directly affect them. For example, FESS will provide personnel to coordinate related activities with the Construction Manager and Construction Coordinator.

The Project Baseline identifies the basis for evaluating project performance. The components are the Work Breakdown Structure, which identifies each component of the project, the Baseline Costs, Escalation Rates, and Baseline Schedule and Milestones.

Work Breakdown Structure (WBS) Dictionary

Listed below is an overview of the WBS dictionary for the C-0 Outfitting project. Further breakdown of the listed structure will be applied as required for accounting and project tracking purposes in the Open Plan schedule.

Engineering, Design and Inspection
ED&I activities include the engineering and design activities in Titles 1 and II, the inspection activities associated with Title III. The descriptions are based on DOE Directive G430.1-1, Chapter 6. In addition, DOE Directive G430.1-1, Chapter 25 was used as guidance in estimating the ED&I costs for this project. The appendix of this document contains these chapters.

Administration
Administration activities include those defined by DOE Directive G430.1-1, Chapter 6 as Project Management (PM) and Construction Management (CM). The appendix of this document contains this chapter of the DOE Directive.

Fixed Price Construction Contracts
Two or more Fixed Price Construction Contracts will be used for the majority of construction work associated with the C-0 Outfitting Project. All lower level tasks will be tracked for progress. Costs and payments will be based on percentage of installed product based on approved cost loaded construction schedule prepared by the Subcontractor.

Direct Procured Purchases
Items have been identified for direct procurement. These Items will be tracked individually.

Time and Materials (T&M)
No T&M work is anticipated at this time. In the event T&M is deemed appropriate it will be costed with the associated Fixed Price Construction Contract project and task.

For accounting purposes, the management reserve of the above listed WBS items will be included in the WBS items, when costed. DOE Directive G430.1-1, Chapter 11 was used as guidance in estimating the appropriate management reserve for this project. The appendix of this document contains this chapter of the DOE Directive.

For accounting purposes, the indirect costs of the above listed WBS items will be included in the WBS items, when costed. For reference purposes Indirect Costs rates are defined by DOE Order 4700.1 that states indirect costs are "...costs incurred by an organization for common or joint objectives and which cannot be identified specifically with a particular activity or project. The multipliers used in this document are based on current Fermilab rates in effect as of October 2002. The appendix of this document contains this current Fermilab Indirect Cost rates.

Baseline Project Costs

The Total Estimated Cost (TEC) for WBS 3.0, C-0 Outfitting, is estimated to be $7,176,914.

No Escalation, Full material Procurement 'Burdened'

Activity ID	Activity Description	Base Budget	Materials & Services Contingency ($)	Total Budget (Base + Contingency)
CONSTRUCTION				
3.1 -- C-0 Outfitting Phase 1				
		$2,239,237	$447,847	$2,687,084
3.2 -- C-0 Outfitting Phase 2				
		$2,303,017	$460,603	$2,763,621
3.3 -- C Sector High Voltage Power Upgrade				
		$774,768	$154,953	$929,722
3.4 -- Pre Procured Items				
		$663,739	$132,747	$796,487

Escalation

The project baseline has been estimated in first quarter FY 2005 dollars. Escalation will be applied to the baseline costs based on the project's integrated schedule in the Open Plan system and escalation applied in Cobra. DOE Directive G430.1-1, Chapter 10 will be used as guidance in estimating the appropriate escalation for this project. The appendix of this document contains this chapter of the DOE Directive. Escalation will be included in WBS 3.0 Project Management.

Baseline Project Schedule and Milestones

The baseline schedule listed below sets forth the major activities and milestones essential for the completion of the project. The milestones are defined as:

MILESTONE	DEFINITION	BASELINE
MS-0 Start Project	Directive signed	Month 0
3.5.1 Lev1Mil: MS-1 Start Engineering	Engineering work for the project starts when a task is entered into the Task Database	Month 1 01Oct04
3.5.2 Lev2Mil: MS-2 Start Construction	Notice To Proceed Issued	Month 4 28Jan05
3.5.3 Levl3Mil: MS-3 Side Bay. Struct. Complete	Structural steel installed, Concrete floor deck formed, and poured. Formwork removed read finishes.	Month 12 26Oct05
3.5.4 Levl3Mil: MS-4 Temp. Power Operational (Fdr 45)	Substation installed with secondary complete to 2000 Amp switchboards, new air switch installed at B-4, duct bank installed between B-4 and C-0 switch pad. Feeder between B-4 and C-0 Building.	Month 19 17May06
3.5.5 Lev2Mil: MS-5 Ben. Occ. of El: 715 & Receiving	Masonry walls installed and painted. Major mechanical equipment in place. Upper assembly loading dock and crane available to lab for one day per week. Power supply switchboard in place and energized. Subcontractor has limited access to El. 715 slab.	Month 16 17Jan06
3.5.6 Lev2Mil: MS-6 Coll. Hall Complete	Fire detection and electrical panel boards installed and energized.	Month 25 02Nov07
3.5.7 Levl3Mil: MS-7 MECH Systems Complete	All Mechanical equipment installe balanced and tested.	Month 23 19Sep07
3.5.8 Levl3Mil: MS-8 Electrical Systems Complete	All electrical complete and tested.	Month 22 02Aug07
3.5.9 Lev1MIL: MS-9 Construction Complete	Punch list complete. Building commissioning complete. Final acceptance of all work	Month 22 05Oct06
3.5.10 Lev2Mil: MS-10 Engineering Complete	Completion of Close-out Documents	Month 26 08Dec06

Funding Profile
Listed below are the anticipated total costs by fiscal year for this project as contained in the Fermilab Project Request Form.

The project management, construction management, design, construction and inspection for this project is being performed in compliance with the applicable DOE Orders and Laboratory Policy and Procedures and in accordance with the Work Breakdown Structure.

Design

If appropriate, the development of working drawings and bid packages may be accomplished by use of an Architectural-Engineering (A/E) firm in conjunction with the FESS/Engineering Project Team during Title II. The selection of the A/E firm will be based on qualifications and past performance on similar FESS projects. Existing professional services contract will be used to accomplish this work.

The A/E may be retained during Title III for engineering support of the following:

- Bid Period Information Requests;
- Amendment/Addendum Development;
- Shop Drawing/Submittal Review;
- Assistance in estimating and negotiating changes to the subcontracted work;
- Responding to subcontractor request for information including developing sketches/revisions to the subcontract documents
- Periodic site visits;
- Punchlist development.

Construction

The FESS/Engineering group will function as the construction manager for the construction projects, coordinating the subcontractor's construction contract. Field inspection, environment, safety and health, and quality control of construction activity will be the responsibility of the subcontractor. FESS/Engineering will provide quality and safety assurance during construction.

<u>Contract Packages</u>

The majority of the construction work for this project will be accomplished by means of one or more construction packages. The Civil Construction packages will be a competitively bid, lump sum contract. A Time and Materials (T&M) task may be used for preparatory work that is specialized and difficult to include in the competitive procurement process.

Possible Sources for the Civil Construction
Fermilab has access to several Subcontractors that have sufficient qualifications to execute this Subcontract.

Performance Based Incentive Process
The subcontractor will be paid only for work completed. In addition, retention may be reduced from 10% to as little as 2% during the subcontract if the subcontractor maintains a safe environment and meets subcontract milestones.

Methods of Competition
The Request for Proposal (RFP) process will be used to solicit proposals from area Subcontractors with the appropriate safety records and experience to accomplish this work.

Source Selection Process
A Source Evaluation Team (SET) will be established which will include the Project Manager, Construction Manager, and Procurement Officer to evaluate and select a Subcontractor for the Civil Construction Package. Evaluation criteria will be included in the RFP documents as a basis for the SET evaluation of proposals.

Justification for Non-competitive Acquisitions
Anticipated non-competitive acquisitions may include T&M tasks and pre-procured items requiring longer than expected fabrication or delivery time. These items will be identified during the Title 2 phase.

Milestones for Acquisition
Construction milestones will be established for inclusion into the subcontract documents.

Cost Control

A separate cost account will be maintained for the following elements listed in the project WBS: Engineering Design and Inspection (ED&I), Administration, and Construction. The baseline budget for each element will be shown on all reports. Costs accrued by these accounts will be reported monthly on a report issued by the Business Services Section (BSS). The Project Manager will review the report and verify the validity of all cost charges during the reporting period, that commitments are correct and that projections of costs can be covered by the baseline budget for each work element.

The Project Manager has the responsibility for the use and commitment of project funds. Any costs or commitments that are made without his signed approval or that of higher Laboratory management may be rejected. Progress payments to the Architect/Engineer, suppliers, and subcontractors will be made upon receipt and approval of acceptable invoices, nominally on a monthly basis.

The Project Manager, within his authorized limits, will be responsible for the administration of the project's management reserve funds.

The Funding Profile, depicted in Section E, is based on the current DOE funding profile. This plan reflects the best estimate of funding levels and the baseline schedule. The Funding Profile establishes the planned rate of accrued costs for the life of the project. The Project Manager is responsible for updating, as needed, the project Estimate at Completion (EAC) for each work element to reflect changes in design and construction, and for overall project fiscal management.

Schedule Control

The Baseline Schedule, shown in Section E of this report, depicts the milestones and their expected achievement dates. As the project develops, the schedule may be further refined. The Project Manager shall have the responsibility to monitor and control these tasks within the baseline. The baseline may be revised with DOE Fermi Area Office concurrence.

The Project Team will review work progress with the subcontractor at regular intervals. Any identified difficulties will require the subcontractor to provide a plan for their resolution. Significant schedule slippage will be cause for expediting actions by BSS at the request of the Project Manager.

Change Control Procedures and Authorities

Changes to the project baseline can occur to the scope, cost, or schedule aspects of the project. Changes at WBS Level 1 and below will be made with the approval of the Project Manager for cost changes up to $75,000 and schedule changes up to 3 months. Cost and schedule changes above these amounts and changes to the scope of the project as outlined in the CDR will require the approvals of the Change Control Board. Any change to the Total Project Cost will require the approval of the Change Control Board and DOE Fermi Area Office. Project change control will be accomplished in accordance with practices listed below.

Change Control Procedures

Change	Approval Required	Change Request Form
Normal Field Changes no added cost or time	Project Engineer and Construction Manager	None
In scope ≤$75k or ≤3 mos. schedule change	Project Manager And Construction Manager	None
In scope >$75k or >3 mos. schedule change	Control Board	Required
Total Project Cost	Control Board DOE Fermilab Directorate	Required
Non-Emergency Required for ES&H regulations	Control Board	Required
Change to Project Scope or Schedule	Control Board DOE Fermilab Director	Required

The Change Control Board (Control Board) will be comprised of the following named individuals or the designees:

DOE Fermi Area Office	P. Philp (non-voting)
Fermilab Directorate	K. Stanfield
Fermilab PPD	J. Cooper
Fermilab FESS	D. Nevin
Fermilab Business Service Section	D. Carlson
Project Manager, Chair	J. Butler
Project Engineer/Construction Manager	T. Lackowski

The Project Manager will act as Chair to the Control Board. The Control Board will consider the change requests promptly and, in cases not requiring additional information or discussion, will respond within two weeks.

Integrated Safety Management (ISM)
Fermilab subscribes to the philosophy of Integrated Safety Management (ISM), in accordance with Department of Energy Order 413.3 “Program and Project Management for the Acquisition of Capital Assets.” Fermilab requires its subcontractors and sub-tier subcontractors to do the same. ISM is a system for performing work safely and in an environmentally responsible manner. The term “integrated” is used to indicate that the Environment, Safety & Health (ES&H) management systems are normal and natural elements of doing work. The intent is to integrate the management of ES&H with the management of the other primary elements of construction: quality, cost, and schedule.

The subcontractors shall submit proof of an effective integrated safety management program. The program must be described in the terms listed below.

- Line Management Responsibility for Safety;
- Clear Roles and Responsibilities;
- Competence Commensurate with Responsibility;
- Balanced Priorities;
- Identification of Safety Standards and Requirements;
- Hazard Controls Tailored to Work Being Performed;
- Operations Authorization.

Quality Assurance
All aspects of this project will be periodically reviewed with regard to Quality Assurance issues from Conceptual Design through Title III completion. This review process will be completed in accordance with the applicable portions of the Director’s Policy Manual, Section 10. The following elements will be included in the design and construction effort:

- An identification of staff assigned to this project with clear definition of responsibility levels and limit of authority as well as delineated lines of communication for exchange of information;
- Requirements for control of design criteria and criteria changes and recording of standards and codes used in the development of the criteria;
- Periodic review of design process, drawings and specification to insure compliance with accepted design criteria;
- Identification of underground utilities and facility interface points prior to the commencement of any construction in affected areas;

- Conformance to procedures regarding project updating and compliance with the approved construction schedule;
- Conformance to procedures regarding the review and approval of shop drawings, samples test results and other required submittals;
- Conformance to procedures for site inspection by Fermilab personnel to record construction progress and adherence to the approved contract documents;
- Verification of project completion, satisfactory system start-up and final project acceptance.

Sustainable Building Design
The project processes and each project element are evaluated to reduce their impact on natural resources without sacrificing program objectives. Fermilab designs will incorporate maintainability, aesthetics, environmental justice and program requirements to deliver a well-balanced project. If appropriate, internal and external reviews of design and construction provide a check and balance system for environmental, aesthetic and maintenance issues.

Reliability and Maintainability
Both reliability and future maintenance are considered in the design of all components of Fermilab site. Materials and construction techniques are selected during the design process to provide adequate design life, accessibility, and minimal maintenance.

Value Engineering
It is not anticipated that a separate value engineering exercise will be required for this project. However, internal reviews of designs at various levels of completion will be performed by the most experienced individuals at Fermilab with the goal that more cost effective solutions will be identified.

Risk Management
The majority of the risk management on this project involves the coordinated activities affecting ongoing Fermilab operations. Sufficient schedule float is currently anticipated for the activities related to constructing project to accommodate potential disruptions.

Design Reviews
Internal design reviews are performed at approximately 50% completion and 100% completion. Designs are checked for conformance to project requirements at each review.

The objective of the reporting and review activity is to provide the assemblage and integration of project related cost data, schedule status and performance progress into reports for the monitoring and management of the project.

Reporting

Daily – If appropriate, construction logs may be prepared by the Construction Coordinator that document the ongoing progress, quality assurance, safety and change issues. When required, the Subcontractor prepares daily quality control reports documenting their efforts on field activities. The Project Manager and Construction Manager are provided these reports on the following workday.

Weekly – The Subcontractor submits a summary report of quality control activities for the previous week at the weekly construction meeting. These reports will include a "look ahead" schedule that details the expected progress in the coming weeks.

Quarterly - The Project Manager will review construction progress, changes, Subcontractor payouts and general project progress in order to prepare a Quarterly GPP report.

Reviews

Directorate Level Review – If appropriate and requested, the project team will meet with the Directorate to review the project related cost data, schedule status and performance progress.

Multi-Organization Construction Site Safety Walkthrough – These walkthroughs will occur on a bi-weekly basis or as requested by the participants. The walkthroughs will be completed in accordance with the ES&H section procedure. A copy of the procedure is included in the Appendix of this document.

This appendix contains:

- Integrated Project Team Responsibility Matrix
- DOE Directive 430.1-1 Chapter 6
- DOE Directive 430.1-1 Chapter 10
- Escalation Rate Assumptions For DOE Projects
- DOE Directive 430.1-1 Chapter 11
- DOE Directive 430.1-1 Chapter 25
- Multi-Organization Construction Site Safety Walkthrough Procedure

INTEGRATED PROJECT TEAM
RESPONSIBILITY MATRIX

Phase of Work	Project Directors	Project Manager	WBS 1.10 Level 2 Manager	WBS 3.0 Level 2 Manager	Directorate	Div/ Sect Head	Procurement	Business Services Legal	Accounting	FESS Management (1)	Project Engineer	FESS Construction Manager	Construction Coordinator	Environment	ES&H Health & Safety	Security
	J. Butler / S. Stone	TBD	J. Howell	T. Lackowski	K. Stanfield	J. Cooper	TBD	TBD	Department	D. Nevin	T. Lackowski	T. Lackowski	TBD	R. Walton	TBD	TBD
Preliminary Design																
set up Engineering task	define project					assess resource availability					define project					
		approve Engineering task			review Engineering task					review Engineering task	submit Engineering task					
		establish T2 performance baseline with PE									establish T2 performance baseline with PM					
						establish budget code				identify available resources	coordinates engineering resources, selection, tasking					
select & task A/E							issue A/E RFP				draft A/E RFP					
				approve selection			establish contract w/ A/E	assist w/ contracting		approve selection	review proposals, select A/E					
		approve tasking					establish task w/ A/E			approve tasking	initiate task requisition					
prepare CDR			coordinate customer team document requirements		provide aesthetic input	provide resources as required				provide resources as required	directs design effort					
			monitor design efforts								interface w/ customer					
CDR approval	approve CDR	approve CDR		approve CDR	approve CDR	approve CDR				approve CDR	submit for approval					
prepare PEP/AP				assist preparation of PEP/AP			assist preparation of PEP/AP	assist preparation of PEP/AP			develop PEP/AP			assist preparation of PEP/AP	assist preparation of PEP/AP	assist preparation of PEP/AP
approve PEP/AP	approve PEP/AP	approve PEP/AP		approve PEP/AP	approve PEP/AP	approve PEP/AP				approve PEP/AP	submit for approval					
prepare NEPA documentation	submit PIF to ES&H									interface with ES&H	draft PIF			review PIF		
														submit recommendation to DOE		
prepare project request form	approve &submit project request	approve &submit project request			create & submit directive request (Budget office)	approve PRF				approve PRF	draft PRF			review submittal		
lab-wide review	review & comment	review & comment	review & comment	approve for release			review & comment	review & comment		review & comment	coordinates CDR review, comment resolution			review & comment	review & comment	review & comment
submit package to Directorate	participate in director review	participate in director review	participate in director review	participate in director review	organize director review	participate in director review	participate in director review			participate in director review	participate in director review					
					aesthetic approval											
					approve project submission											
submit package for Construction Directive Authorization					submit Construction Directive Authorization											
establish funding		request work package			create work package (Budget office)											
cost tracking & control		receive design progress and costs reports		monitor design progress and costs					provide timely cost data to PM	track/invoice FESS Engineering costs	track/project engineering costs					
				approve A/E invoices			approve A/E invoices			approve A/E invoices	review/approve A/E invoices					
project filing				monitor filing						monitor filing	maintain project files					
Final Design																
select & task A/E							issue RFP				draft A/E RFP					
		approve selection		approve selection			establish contract w/ A/E	assist w/ contracting		approve selection	review proposals, select A/E					
		approve tasking		approve tasking			establish task w/ A/E (PO)			approve tasking	initiate task requisition					
direction of A/E		approve change orders		approve change orders		approve change orders	issue change orders			approve change orders	interface w/ customer & Lab organizations					
											lead development of construction documents, drawings, exhibits					
cost tracking & control	monitor design progress & costs	monitor design progress & costs		monitor design progress & costs					provide timely cost data to PM	track/invoice FESS Engineering costs	track/project engineering costs					
				approve A/E invoices			approve A/E invoices		pay invoices	approve A/E invoices	review / approve A/E invoices					
change control for design		requirements change control														
		approve changes to design performance baseline	approve changes to design performance baseline								submit changes to dsign performance baseline to PM					
assign Construction Manager			approve assignment	approve assignment						assign construction manager						
design coordination meetings											coordinate and lead meetings					
source evaluation		participate in SET					participate in SET	provide counsel as requested		participate in SET	participate in SET	chair SET				

indicates that action is not to be taken

indicates approval action required

List of Acronyms

A/E	architectural / structural consultant
AP	acquisition plan
BO	beneficial occupancy
CCB	change control board
CDR	conceptual design report
CM	construction manager
D/S	divisions/sections
ICE	independent cost estimate
NTP	notice to proceed
PEP	project execution plan
PIF	project information form (NEPA)
PEP	project engineer
PM	project manager
PO	purchase order
PRF	project request form
QA	quality assurance
RFI	request for information
RFP	request for proposal
SET	source evaluation team

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INTEGRATED PROJECT TEAM
RESPONSIBILITY MATRIX

Phase of Work	Project Directors	Project Manager	WBS 1.10 Level 2 Manager	WBS 3.0 Level 2 Manager	Directorate	Div/ Sect Head		Business Services				FESS			ES&H				
							Procurement	Legal	Accounting	FESS Management (1)	Project Engineer	Construction Manager	Construction Coordinator	Environment	Health & Safety	Security			
Exhibit A&B							assist in writing Exhibit A	provide counsel as requested			coordinate writing of Exhibit A&B	assist in writing Exhibit A							
lab-wide design review				approve for release			review & comment	review & comment		review & comment	coordinates review, comment resolution	review & comment		review & comment	review & comment	review & comment			
cost tracking & control		monitor design progress		monitor design progress							coordinate engineering resources, selection, tasking, invoices								
	monitor project costs	monitor project costs		monitor project costs															
		approve A/E invoices		approve A/E invoices			approve A/E invoices		pay invoices	approve A/E invoices	review / approve A/E invoices								
												establish CCB for T3							
value engineering (tailored)			participate in value engineering	participate in value engineering						participate in value engineering	coordinate & conduct value engineering	participate in value engineering							
Title II estimate & schedule				review T2 construction estimate & schedule						review T2 construction estimate & schedule	lead development of T2 construction schedule and estimate								
ICE schedule & estimate		review ICE for cost & schedule		review ICE for cost & schedule						review ICE for cost & schedule		develop ICE for cost & schedule							
design sign-off	sign-off	sign-off	sign-off							sign off	sign off	sign off							
develop RFP		review RFP documents		review RFP documents			develop RFP documents				review RFP documents	review RFP documents							
assemble proposal documents							assemble proposal documents				assemble drawings, specs, Exhibit A								
regulatory permits	monitor permitting process	monitor permitting process		monitor permitting process				provide counsel as requested		identify required permits	identify required permits	monitor permitting process		identify required permits					
										provide permit information	provide permit information			prepare permit application					
		approve permit submittal								approve permit submittal				submit application to DOE					
performance baseline for construction		reconcile T2 & ICE schedule & estimate		reconcile T2 & ICE schedule & estimate							reconcile T2 & ICE schedule & estimate	reconcile T2 & ICE schedule & estimate							
		establish T3 performance baseline with CM		establish T3 performance baseline with CM								establish T3 performance baseline with PM							
update PEP/AP				update PEP/AP								assist update PEP/AP							
project reporting	periodic updates to Lab management	periodic updates to Lab management									provide input for periodic updates to Lab management	provide input for periodic updates to Lab management							
	quarterly reports to DOE	quarterly reports to DOE									provide input for quarterly reports to DOE	provide input for quarterly reports to DOE							
directive mods		review & approve requests, submit to DOE		prepare requests for directive mods, submit to D/S	review & approve requests, submit to DOE	review & approve requests, submit to Directorate						assist preparation of directive mods							
project filing				monitor filing			maintain project files			monitor filing	maintain project files								
Procurement CD-3																			
issue RFP							issue RFP					initiate construction requisition							
pre-proposal meeting		participate in pre-proposal meeting		participate in pre-proposal meeting			coordinate & chair pre-proposal meeting				participate in pre-proposal meeting	participate in pre-proposal meeting			participate in pre-proposal meeting				
requests for information							issue replys to RFIs				prepare replys to RFIs	review & approve replys to RFIs							
ammendments				review & approve ammendment packages			issue ammendments			review & approve ammendment packages	assemble ammendment packages	review & approve ammendment packages							
proposal evaluations		participate in SET		participate in SET			participate in SET	provide counsel as requested		participate in SET	participate in SET	chair SET			evaluate safety submittals				
							review proposals for business related issues					evaluate corporate quality control plan							
												evaluate schedule submittal							
												forward recommendation to source selection officer							
negotiations	approve negotiation	approve negotiation		approve negotiation			assist in negotiations	provide counsel as requested				conduct negotiations							
subcontract award												initiate requisition for proposal							
		approve award		approve award			award subcontract	provide counsel as requested				approve award		review /accept safety documentation					
update performance baseline for construction		chair CCB								participate in CCB		participate in CCB							
				incorporate approved changes															

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INTEGRATED PROJECT TEAM
RESPONSIBILITY MATRIX

Phase of Work	Project Directors	Project Manager	WBS 1.10 Level 2 Manager	WBS 3.0 Level 2 Manager	Directorate	Div/ Sect Head		Business Services				FESS			ES&H				
							Procurement	Legal	Accounting	FESS Management (1)	Project Engineer	Construction Manager	Construction Coordinator	Environment	Health & Safety	Security			
project filing				monitor filing			maintain project files			monitor filing	maintain project files	maintain project files							
Construction																			
pre-construction meeting				participate in pre-construction meeting			coordinate & chair pre-construction meeting					participate in pre-construction meeting	participate in pre-construction meeting	participate in pre-construction meeting	participate in pre-construction meeting	participate in pre-construction meeting			
ES&H Plan												review plan	review plan		review / accept plan				
project quality control plan												review/ authorize plan	review / accept plan						
SESC plan											review plan	review/ authorize plan	review / accept plan						
hazard analysis review / acceptance												review/ authorize plan	review / accept		assist review as requested				
Fermilab permits												monitor process and currency	obtain and maintain currency	oversight of process					
Notice To Proceed							issue NTP					approve NTP	assure precursers are in place						
cost loaded schedule review / acceptance				review & comment								review / accept	review & comment						
submittal list review												review	review / accept						
oversight / direction of A/E		approve change orders		approve change orders			issue change orders			approve change orders	initiate change orders & reqs	approve change orders							
							contract oversight - funding / currency			monitor A/E performance	tasking / direction of A/E effort	monitor A/E performance							
daily inspections / reports										safety support as requested		monitor QA program	daily QA inspections for technical & safety program compliance		safety support as requested				
		monitor progress, trends		monitor progress, trends						monitor progress, trends		issue daily construction report to PM, PE, FESS mgmt	daily construction report to CM						
ES&H inspections / reports	monitor safety program	monitor safety program		monitor safety program								monitor safety program		periodic walkthroughs	periodic walkthroughs				
manhour reports							review DB payroll submittals						obtain manhour reports from subcontractor						
deficiency log												monitor deficiency log	maintain deficiency log						
shop drawing review											coordinate shop drawing reviews	monitor shop drawing status	participate in shop drawing reviews						
											issue actions	approve actions							
											maintain shop drawing log								
engineering change proposals		review / approve		review / approve			issue request to sub			review / approve	initiate request	approve request							
revisions		review / approve		review / approve			issue revision to sub			review / approve	coordinate documents	approve revision							
engineering change requests		review / approve		review / approve			issue change to sub			review / approve	initiate change w/ req	approve change							
claim review / negotiations		assist review / negotiations		assist review / negotiations			assist review / negotiation	provide counsel as requested		assist review	assist review	lead review / negotiation	assist review						
		approve settlements		approve settlements			issue related correspondence												
supplemental agreements							issue supplemental agreements					approve supplemental agreements							
non-compliance memos		monitor non-compliance memos		monitor non-compliance memos			provide counsel as requested	provide counsel as requested			monitor non-compliance memos	issue non-compliance memos	draft non-compliance memos						
weekly construction meeting							attend as requested				attend as requested	chair meetings	attend as requested		attend as requested				
weekly project team meeting		participate in meetings	participate in meetings	participate in meetings			participate in meetings			participate in meetings	participate in meetings	chair meetings	participate in meetings		participate in meetings				
PMG meetings	participate in meetings	participate in meetings		participate in meetings	participate in meetings	participate in meetings	participate in meetings			participate in meetings	participate in meetings	lead presentation	participate in meetings		participate in meetings				
quarterly DOE reports	approve / submit reports											draft reports							
cost tracking & control	monitor construction progress	monitor construction progress		monitor construction progress					provide timely cost data to CM, PM	track/invoice FESS Engineering costs	track/project engineering costs	monitor construction progress	effort & progress reporting						
	monitor project costs	monitor project costs		monitor project costs															
subcontrator progress updates				review & comment on schedule update submittals			review & comment on schedule update submittals			monitor update process		conduct progress updates w/ subcntractor	review & comment on schedule update submittals						
invoice approvals (sub & A/E)				approve invoices			approve invoices			approve invoices	review/approve A/E invoices	review/approve A/E & Subcontractor invoices	assure invoice checklist is complete						
punch list													review & comment on subcontractors punchlist						
				coordinate customer walkthroughs			monitor punchlist activity			monitor punchlist activity	coordinate Engineering portion of walkthroughs		coordinate punchlist walkthroughs						
												transmit punchlist to subcontractor	assemble Lab punchlist						

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INTEGRATED PROJECT TEAM
RESPONSIBILITY MATRIX

Phase of Work	Project Directors	Project Manager	WBS 1.10 Level 2 Manager	WBS 3.0 Level 2 Manager	Directorate	Div/ Sect Head		Business Services				FESS			ES&H	
							Procurement	Legal	Accounting	FESS Management (1)	Project Engineer	Construction Manager	Construction Coordinator	Environment	Health & Safety	Security
													monitor completion of punchlist items			
beneficial occupancy				coordinate customer div/sect responsibilities									coordinate walkthroughs			
		approve B.O.					approve B.O.			approve B.O.		transmit B.O. to subcontractor	initiate B.O. Form			
final acceptance		approve final acceptance					approve final acceptance			approve final acceptance		transmit final acceptance to subcontractor	initiate final acceptance form			
update PEP/AP				update PEP/AP								assist update PEP/AP				
incident investigations													initiate call tree			
													obtain report form subcontractor	monitor process	monitor process	monitor process
	monitor response to incident	monitor response to incident		monitor response to incident						assist as required		issue incident report	prepare report for CM	assist as requested	assist as requested	assist as requested
lessons learned										develop lessons learned			assist as requested			
ES&H compliance	monitor safety compliance	monitor safety compliance		monitor safety compliance			monitor safety compliance			assist on technical issues		interface w/ subcontractor on issues	attend safety meetings		assist on technical issues as requested	
										monitor safety compliance		monitor safety compliance	assure subcontractor compliance		monitor safety compliance for PM	
environmental compliance	monitor environmental compliance	monitor environmental compliance		monitor environmental compliance			monitor environmental compliance			assist on technical issues		interface w/ subcontractor on issues	assure subcontractor compliance	assist on technical issues as requested		
										monitor environmental compliance		monitor environmental compliance		monitor environmental compliance for PM		
as-builts													assure as-builts kept current / accurate			
change control for construction				requirements change control												
		approve changes to constructon baseline										submit changes to construction baseline				
directive mods		prepare requests for directive mods, submit to D/S			review & approve requests, submit to DOE	review & approve requests, submit to Directorate										
project filing				monitor filing			maintain project files			monitor filing	maintain project files	maintain project files				
Close-out CD-4																
subcontractor performance reviews													submit personal review to FESS mgmt.			
		participate in review		participate in review			coordinate & lead review			participate in review		participate in review	participate in review		participate in review	
final payment/release retention				approve invoices			approve invoices			approve invoices		review/approve Subcontractor invoices	assure invoice checklist is complete			
							move open items to warrantee						move open items to warranty			
level1 budget close				assure all commitments in place								assure all commitments in place				
				request budget close	activate level 1 budget close	approve budget close										
notice of project closout		submit request				approve closeout										
final budget close					activate final budget close											
final directive		prepare request for directive mods, submit to D/S			review & approve request, submit to DOE	review & approve request, submit to Directorate						assist preparation of directive mods				
project filing				monitor filing			maintain project files			monitor filing	maintain project files	maintain project files				

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CHAPTER 6

PROJECT FUNCTIONS AND ACTIVITIES DEFINITIONS FOR TOTAL PROJECT COST

1. INTRODUCTION

Because of an obvious disparity of opinions and practices with regard to what exactly is included in total estimated cost (TEC) and total project cost (TPC), guidelines were developed and are included in this chapter. The development of guidelines is important because it provides consistency in estimating and reporting of project costs and it provides uniformity of information used for cost data bases. It should be noted that TEC does not apply to most of the EM projects; only TPC applies.

2. DEFINITIONS

Total project cost is defined as all costs specific to a project incurred through startup of a facility, but prior to the operation of the facility. Thus, TPC includes TEC and other project costs (OPC), or

$$TEC + OPC = TPC.$$

A. Total Estimated Cost

TEC is defined as all engineering design costs (after conceptual design), facility construction costs, and other costs specifically related to those construction efforts. These are typically capitalized. TEC will include, but not be limited to: project and construction management during Titles I, II, and III; design and construction management and reporting during design construction; contingency and economic escalation for TEC-applied elements; ED&I during Titles I, II, and III; contractor support directly related to design and construction; and equipment and refurbishing equipment.

B. Other Project Costs

OPCs are defined as all other costs related to a project that are not included in the TEC, such as supporting research and development, pre-authorization costs prior to start of Title I design, plant support costs during construction, activation, and startup. OPCs will include, but not be limited to: research and development; NEPA documentation; project data sheets (PDSs); CDR; short form project data sheets; surveying for siting; conceptual design plan; and evaluation of RCRA/EPA/State permit requirements.

C. Total Project Cost

TPC is defined as all costs specific to a project incurred through the startup of a facility but prior to the operation of a facility. It is comprised of TEC and OPC. TPC will include, but not be limited to, activities such as: design and construction; contingency; economic escalation; Pre-Title I activities; feasibility study reports (FSRs); maintenance procedures (to support facility startup); one-time start-up costs, initial operator training, and commissioning costs; and operating procedures (to support facility start-up).

3. DISCUSSION OF CHARTS

Table 6-1 is a matrix that summarizes the different individual project activities and indicates their designation with respect to TPC and TEC. The project activities identified are divided into different phases of project development. The activities are charged to the different functions that comprise TEC and OPC and are shown in the sequence they would most likely occur.

A. Different Phases of Project Development

The different individual project activities identified are divided into different stages of project development. The first section of the matrix identifies activities encountered during pre-authorization or Pre-Title I design. The second section of the matrix identifies activities encountered during Titles I and II of design. The matrix progresses in that manner to include Title III design and start-up.

B. Different Functions of Total Estimated Cost and Other Project Cost

The different project activities are allocated to different project functions with respect to TEC and OPC. The activities are designated as based on the project phase under which the activity occurs.

1. Total Estimated Cost

TEC is divided into costs associated with ED&I, project management (PM), construction management (CM), and construction contractors (CC).

a. ED&I: ED&I activities include the engineering and design activities in Titles I & II, the inspection activities associated with Title III, and activities defined in the Brooks Bill (e.g., the 6 percent allowed for design, drawings, and specifications).

b. PM: Project management covers those services provided to the DOE on a specific project, beginning at the start of design and continuing through the completion of construction, for planning, organizing, directing, controlling, and reporting on the status of the project.

c. CM: Construction management covers those services provided by the organization responsible for management of the construction effort during Title I and Title II design, and continuing through the completion of construction. CM services are further defined in DOE Order 4700.1, PROJECT MANAGEMENT SYSTEM.

d. CC: Construction contractors cover salaries, travel, and other expenses of engineers, engineering assistants, and their secretarial support responsible for engineering and design performed by the construction contractor. When work normally performed by an architect/engineer (A/E) is performed by a CC, the associated costs are charged to the applicable ED&I accounts.

2. Other Project Cost

Any activities that are not representative of TEC functions are allocated to OPC. They are typically Pre-Title I activities, startup costs, and some support functions.

4. COST ALLOCATIONS

The definitive document within DOE for allocations of cost is DOE Order 2200.6, FINANCIAL ACCOUNTING, but a general discussion of cost allocations follows.

A. Plant and Capital Equipment (PACE) Fund

The Plant and Capital Equipment (PACE) Fund provides funding for the plant and its basic equipment/furnishings. This fund is for conventional construction projects only.

B. Operating Expense Fund

The Operating Expense Fund provides funding for ongoing activities, such as laundry, cleaning, etc. These items are typically captured in site overhead accounts and then allocated to projects as site overhead. Operating expense funded items more directly related to projects are items such as Pre-Title I and start-up activities, etc.

C. Usage

Once standard definitions are developed and the different project activities are identified, it is then possible to uniformly allocate costs to the different project development activities. Table 6-2 is a matrix that summarizes recommended cost allocations for operating expense and PACE (ED&I and construction). It is important to note that the estimator should refer to these tables throughout the entire life of a project.

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
1. PRE-KEY DECISION - 0 (Prior to Determination of Mission Need)					
A. Engineering Study	X				
B. Alternatives Assessment/Site Selection Studies	X				
C. Surveying for Siting	X				
D. Capital Review Board	X				
E. Candidate Projects (support sheet and presentation to DOE)	X				
F. Conceptual Design Plan	X				
G. Work Orders - CDR Preparation, etc.	X				
H. Integrated Programmatic/Project Schedule (R&D, Safety, Environmental, Operations, etc.)	X				
I. Requirements for Safety Analysis Determination	X				
J. Functional Design Criteria	X				
K. Evaluation of RCRA/EPA/State Permit Requirements	X				
L. Cultural Resources Review	X				
2. Key Decision - 0 and Key Decision - 1 (Determination of Mission Need and Approval of New Start)					
A. Conceptual Design Report	X				
B. Design Reviews	X				
C. NEPA Documentation	X				
D. Conceptual Project Schedule	X				
E. Plant Forces Work Review	X				
F. Energy Conservation Report	X				

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
G. Economic/Life Cycle Cost Analysis	X				
H. Alternative Engineering (before Title I)	X				
I. Physically Handicapped Review	X				
J. Energy System Acquisition Advisory Board and Acquisition Executive Review Board Support	X				
K. Preliminary Safety Analysis Report (PSAR)	X				
L. Facility/Project Security Review and Plan	X				
M. Facility Security Vulnerability Assessments	X				
N. Master Safeguards & Secure Analysis	X				
O. Construction Project Data Sheet (CPDS)	X				
P. ES&H Requirements Assessment	X				
Q. Strategic Facility Assessment	X				
R. Budget/Conceptual Estimates, as required (Parametric Assessments)	X				
S. Project/Validations Support	X				
T. Monthly Conceptual Status Report	X				
U. Architect/Engineer (A/E) Selection and Statement of Work Development	X				
V. Identification of Project Record Requirements	X				
W. Project Management Plan (PMP)	X				
X. Project Quality Assurance (QA) Plan	X				
Y. Configuration Management Plan (CMP)	X				

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
Z. Pilot Plants	X				
AA. Research and Development (Project Specific)	X				
AB. Facility As-Built/Existing Condition Drawings (Prior to Design Start)	X				
AC. Obtain Permits Required Prior to Start of Construction (before Title I)	X				
3. Key Decision - 1 and Key Decision - 2 (Approval of New Start and Start of Detailed Design: Title I and II Activities)					
A. PMP Revisions			X		
B. CPDS Revisions			X		
C. Integrated Detailed Project Schedules/Critical Path Analysis			X		
D. Project Revalidations			X		
E. Project Authorization Modification Support			X		
F. A/E Internal Design Coordination		X			
G. Identification of Long Lead Procurements		X			
H. Design Studies		X			
I. Design Calculations & Analysis		X			
J. CADD and other Computer Services		X			
K. Cost Estimates			X		
L. Procurement & Construction Specification Development		X			
M. Design Reviews by Project Team		X	X		
N. Design Review Support	X	X			

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
O. Drawings		X			
P. Project Schedules			X	X	
Q. Acceptance Test Procedures & Plans		X		X	
R. Certified Engineering Reports		X			
S. Research & Development (required to complete project as defined by KD-0)	X				
T. Performance Evaluations of A/E			X		
U. Inspection Planning			X	X	
V. Surveys - Support Design			X		
W. Design Cost & Scheduling Analysis & Control		X			
X. Decision Progress Reporting		X	X	X	
Y. Design QA Plan and Overview		X	X		
Z. Constructibility Reviews			X	X	
AA. Safety Reviews by A/E		X			
AB. Regulatory Overview by A/E		X			
AC. Reproduction - for Design		X			
AD. Travel - Support Design		X			
AE. Obtain Permits Required Prior to Start of Construction (after Title I)	X				
AF. Change Control - for Design		X	X		
AG. Value Engineering (after Title I)			X		

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
4. Key Decision - 3 Approval to Start Construction or Full Scale Development to Key Decision - 4: Approval to Commence Operations or Pre-Production (Title III Activities)					
A. Bid Package Preparation			X	X	
B. Bid Evaluations, Opening and Award			X	X	
C. Construction Coordination and Planning			X	X	
D. Contract Administration			X	X	
E. Engineering Support (A/E)			X		
F. Design Changes/Control		X	X	X	
G. Non-Conformance Reports (NCRs)			X	X	
H. Control Systems for Construction Activities			X	X	
I. Project Assessment & Reporting		X	X	X	
J. Construction Status Reports and Meetings			X	X	
K. Davis-Bacon Administration			X	X	
L. Vendor Submittals		X	X	X	X
M. Field Support of Construction			X	X	
N. Field or Lab Tests				X	
O. Radiation Control Timekeepers					X
P. Radiation Protection by Contractor			X		
Q. Safety and Safeguard/Security Operations				X	X
R. M&O Contractor/M&O Project Support During Construction	X				
S. Project Estimates (Purpose Dependent)		X	X	X	

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
T. Quality Control (QC) Inspection			X	X	X
U. Inspection and Acceptance		X		X	
V. Negotiations of Fixed Price Contract Changes			X	X	
W. Trips to Vendor/Fabricators		X	X	X	X
X. Procurement Coordination			X	X	X
Y. Equipment/Hardware Cost				X	X
Z. Material Procurement Rate				X	X
AA. Initial Office Furniture and Fixtures					X
AB. Spare Parts Inventory	X				
AC. Installation/Alterations					X
AD. Disposal of Mixed Waste					X
AE. Cost Plus Award Fee/Fixed Price Construction		X			X
AF. Plant Forces Work					X
AG. Initial Spares					X
AH. Safety Plan & Overview				X	X
AI. Decontamination (exceeds normal operating levels)	X				
AJ. Decontamination (as removal cost)					X
AK. Surveying to Support Construction			X	X	X
AL. Interest Penalties		X	X	X	X

TABLE 6-1

TPC AND TEC GUIDANCE AND CLARIFICATION
INCLUSION OF DETAILED ACTIVITIES IN TPC AND/OR TEC

ACTIVITY	TPC				
	OPC	TEC			
		ED&I	PM	CM	CC
5. Key Decision - 4: Planning and Preparation for Acceptance/Operational Startup and Pre-production for Commencement of Operations					
A. Perform Acceptance Testing			X		X
B. Perform Operation Acceptance Testing	X				
C. Final Safety Analysis Report (FSAR)			X		
D. Operational Readiness Review (ORR)	X				
E. Start-up Costs	X				
F. Training of Operators	X				
G. As-Builts		X	X		X
H. Project Closeout			X		
I. A/E & Construction Performance Appraisals			X		
J. User Move-In	X				
K. Develop Operating Procedures, Manuals, and Documentation	X				
L. Operations Planning	X				
M. Safety and System Integration	X				
N. Safety Evaluation Report (SER)	X				
O. Post-Acceptance Testing	X				
P. Start Up Coordination, Materials, and Supplies	X				
Q. Correction of Design/Construction Deficiencies					X
R. Transition Planning			X	X	X

TABLE 6-2

RECOMMENDED GENERAL COST ALLOCATION MATRIX

PROJECT DEVELOPMENT ACTIVITY	PROJECTS [1]		
	OPERATING EXPENSE	P&CE	
		ED&I	CONSTR.
Pre Title I	X		
Title I		X	
Title II		X	
Title III		X	
Construction	X [2]		X
Construction Management			X
Project Management		X [3]	X [3]
Project Support	X		
Startup	X		

[1] Applies to Line Item Projects, Major Projects, and Major Systems Acquisitions.

[2] Capital funding for betterments, conversions, and replacements. Alterations are generally funded by operating expense.

[3] Project management during the design phase of Line Item Projects, Major Projects, or Major Systems Acquisitions authorized for design only is funded by P&CE-ED&I.

Reference: DOE Order 2200.6, FINANCIAL ACCOUNTING.

CHAPTER 10

ESCALATION

1. INTRODUCTION

Escalation is the provision in a cost estimate for increases in the cost of equipment, material, labor, etc., due to continuing price changes over time. Escalation is used to estimate the future cost of a project or to bring historical costs to the present. Most cost estimating is done in "current" dollars and then escalated to the time when the project will be accomplished. This chapter discusses how escalation is calculated and how escalation indices are applied. Additional information can be found in DOE Order 5700.2, COST ESTIMATING, ANALYSIS AND STANDARDIZATION.

2. EXAMPLE OF USE OF ESCALATION

Since the duration of larger projects extends over several years, it is necessary to have a method of forecasting or predicting the funds that must be made available in the future to pay for the work. This is where predictive or forecast escalation indices are used. The current year cost estimate is, if necessary, divided into components grouped to match the available predictive escalation indices. Then each group of components is multiplied by the appropriate predictive escalation index to produce an estimate of the future cost of the project. The future costs of these components are then summed to give the total cost of the project. Escalation accuracy for the total project increases with the number of schedule activities used in summation.

To properly apply escalation indices for a particular project, the following data is required:

- escalation index (including issue date & index) used to prepare the estimate;
- current performance schedule, with start and completion dates of scheduled activities; and
- reference date the estimate was prepared.

Following is an example of a 5-year project that requires escalation calculations to determine the total project costs in the base year's dollars.

TABLE 10-1

EXAMPLE OF 5-YEAR PROJECT REQUIRING ESCALATION CALCULATIONS ESTIMATE REFERENCE DATE: JULY 1, 1992

Step 1 Determine midpoint of scheduled activity.

Scheduled Activity	WBS	Start	Duration Complete	(Months)	Midpoint
1. ED&I Title I	A1A	02/01/94	10/01/94	8	06/01/94
2. ED&I Title II	A1B	11/01/94	04/01/95	6	01/15/95
3. ED&I Title III	A1C	04/01/95	01/01/99	45	02/15/97
4. Equipment Procurement (General Services)	B2A	10/01/94	10/01/97	36	04/01/96
5. Equipment Procurement (Long-Lead, GFE)	B2B	04/01/95	12/01/95	8	08/01/95
6. Facility Construction	B2C	07/01/95	08/01/98	37	01/15/97
7. Demolition Work	D1A	01/01/98	09/01/98	8	05/01/98
8. Project Management	E1A	02/01/94	01/01/99	59	07/15/96

Step 2 Select appropriate escalation rates (assume escalation rates are for 1992 base year).

FY-1992 = 1.0	FY-1995 = 3.5
FY-1993 = 2.4	FY-1996 = 3.7
FY-1994 = 3.1	FY-1997 = 3.8

TABLE 10-1 (continued)

EXAMPLE OF 5-YEAR PROJECT REQUIRING ESCALATION CALCULATIONS ESTIMATE REFERENCE DATE: JULY 1, 1992

Step 3 **Calculate appropriate escalation rates for each scheduled activity using estimate preparation date as starting point and apply escalation rates selected in Step 2 to midpoint dates determined in Step 1.**

For Example: ED&I - Title III (midpoint = 02/15/97)

FY-Period	Years x Escalation Index = Escalation Factor		
07/01/92 to 01/01/93	6/12	.010	.005
01/01/93 to 01/01/94	1.0	.024	.024
01/01/94 to 01/01/95	1.0	.031	.031
01/01/95 to 01/01/96	1.0	.035	.035
01/01/96 to 01/01/97	1.0	.037	.037
01/01/97 to 02/15/97	1.5/12	.038	.005

Compound Escalation

Factor = 1.005 x 1.024 x 1.031 x 1.035 x 1.037 x 1.005 = 1.144 OR 14.4%

Step 4 **The compound escalation factors derived in Step 3 are then applied to the total costs (direct cost + mark ups) for each scheduled activity. Total project escalation is the summation of escalation for all project activities**

Assume costs for Title III design are $100,000 for the base year. The escalated value would be:

$100,000 x 1.144 = $114,400.

Thus, the cost used for Title III designs in the total project cost is $114,400.

Note: Repetition of calculations is obvious; thus, application to a computerized escalation rate analysis forecast program would prove beneficial. Escalation rates applied to scheduled activities are practically tied to the project WBS. Unless a better determination can be made and supported, the midpoint of cash flow for a particular category is set equal to the midpoint of the scheduled activity for that category.

3. ESCALATION RELATIONSHIPS

To compare the costs of projects with differing durations, inflation/escalation costs must be considered. Escalation in cost estimating has two main uses: to convert historical costs to current costs (historical escalation index) and to escalate current costs into the future (predictive escalation index) for planning and budgeting. Historical costs are frequently used to estimate the cost of future projects. The historical escalation index is used to bring the historical cost to the present and then a predictive escalation index is used to move the cost to the future.

Associated with escalation are concepts of present and future worth. These represent methods of evaluating investment strategies like life cycle cost analyses. For example, a typical life cycle cost evaluation would be determining whether to use a higher R factor building insulation at a higher initial cost compared to higher heating and cooling costs over the life of the building resulting from a lower R factor insulation. Present and future worth are discussed in Chapter 23.

A. Historical Escalation

Historical escalation is generally easily evaluated. For example, the cost of concrete differed in 1981 versus 1992. The ratio of the two costs expressed as a percentage is the escalation and expressed as a decimal number is the index. Generally, escalation indices are grouped. For example, all types of chemical process piping may be grouped together and a historical escalation index determined for the group.

B. Predictive Escalation

Predictive escalation indices are obtained from commercial forecasting services, such as DRI/McGraw Hill, which supplies its most current predictions using an econometric model of the United States economy. They are the ratio of the future value to the current value expressed as a decimal. Predictive escalation indices are typically prepared for various groups and may be different for different groups. For example, the escalation index for concrete may be different than the one for environmental restoration.

C. Escalation Application

Economic escalation shall be applied to all estimates to account for the impact of broad economic forces on prices of labor, material, and equipment in accordance with the following requirements.

- Escalation shall be applied for the period from the date the estimate was prepared to the midpoint of the performance schedule.

- Since economic escalation rates are revised at least annually, all estimates shall include the issue date of the escalation rates used to prepare the estimate.

- Costs used for design concept shall be fully escalated and referenced as required.

4. ESCALATION INDICES

Costs continuously change due to three factors: changing technology, changing availability of materials and labor, and changing value of the monetary unit (i.e., inflation). Cost or escalation indices have been developed to keep up with these changing costs. The use of escalation indices is recommended by DOE to forecast future project costs. The use of an established index is a quick way to calculate these costs. To ensure proper usage of an index, one must understand how it is developed and its basis.

A. Developing Escalation Indices

An escalation index can be developed for a particular group of projects. The projects are divided into their elements, which can be related to current industry indices. The elements are then weighted and a composite index is developed. Complete details on developing escalation indices can be found in the DOE Cost Guide, Volume 5, on How to Construct and Use Economic Escalation Indices.

B. Escalation Indices Published by DOE

DOE has developed construction escalation indices for various types of projects. These are published every February and August. A copy of the latest indices can be requested from Office of Infrastructure Acquisition (FM-50).

5. USE OF DOE ESCALATION INDICES

A. How to Select an Index

An index for a project or program is selected based on the type of project (i.e., the scope of work). DOE publishes several indices to cover the range of projects for DOE. If a project or program does not appear to fall into any of the categories, adjustments can be made and must be submitted to FM-50 prior to their use.

More specifically, they must be selected based on the type of cost being escalated since escalation indices represent groups of items. For example, a predictive escalation index for chemical process piping would be inappropriate for use with a cost estimate for a building construction project.

B. How to Apply an Index

The indices are developed with a base year whose index number is 1.0. Generally, the base year is the current year. Once the index is selected, it can be used to either project a current cost based on historical costs, or it can be used to project future costs based on today's dollars.

C. Limitations

Cost indices have limitations since they are based on average data. Thus, judgement is required to decide if an index applies to a specific cost being updated. If using an index for a long-term project, it must be remembered that the long-term accuracy for indices are limited. However, their usefulness to DOE is that the different groups within DOE can use a common index to produce comparable costs.

Escalation Rate Assumptions
For DOE Projects
(January 2003)

	Project Categories *									
FY	**Construction**		**EM**		**IT**		**O&M**		**R&D**	
2002	1.000	N/A	1.000	N/A	1.000	N/A	1.000	N/A	1.000	N/A
2003	1.021	2.1	1.020	2.0	1.008	0.8	1.018	1.8	1.023	2.3
2004	1.046	2.5	1.047	2.7	1.017	0.9	1.045	2.6	1.051	2.8
2005	1.076	2.9	1.075	2.7	1.022	0.5	1.073	2.7	1.080	2.7
2006	1.106	2.8	1.103	2.6	1.032	1.0	1.101	2.6	1.108	2.6
2007	1.135	2.6	1.130	2.4	1.041	0.8	1.127	2.4	1.136	2.5
2008	1.164	2.6	1.157	2.4	1.049	0.8	1.154	2.4	1.164	2.5

These Rates are based on Material and Labor data contained in the Energy Supply Model, provided by DRI-WEFA (now Global Insight), in January 2002. Locally obtained rates, different from those above, may be used. Additional advice and assistance can be obtained from OECM. Points of Contact: T. Ross Hallman, National Energy Technology Laboratory (NETL), 304-285-4837 or Terry Brennan, NETL, 412-386-5989.

* Note that Project Categories are aligned with those Project Categories in the Project Assessment and Reporting System (PARS), which are included as follows:

Construction: (formerly Defense Programs and General Construction Category)
Vertical: Examples: General Building Construction, Administration Buildings, Lab Facilities.

Horizontal: Railroads, Road Work, Bridges, Tunneling, Site Improvements, Site Utilities, Dams / Waterways

Facilities / Infrastructure: Chemical Plants, Vitrification Plants, Process Plants, Incinerators, Accelerators, One-of-a-Kind Facilities, and Modifications.

Environmental Management: (formerly Environmental Management category)
Restoration: Groundwater Remediation, Soils Remediation

D&D/d&d: Reactors, Process Facilities, Administration Facilities, Medical Facilities, Laboratory Facilities, Security Facilities

Information Technology: (***NOT*** formerly a Category or Project Type)
Information Technology and Systems: Hardware, Software, Modeling / Simulation

CHAPTER 11

CONTINGENCY

1. INTRODUCTION

The application of contingency for various types of cost estimates covers the entire life cycle of a project from feasibility studies through execution to closeout. The purpose of the contingency guidelines presented in this chapter is to provide for a standard approach to determining project contingency and improve the understanding of contingency in the project management process. These guidelines have been adopted by the DOE estimating community and should be incorporated into the operating procedures of DOE and operating contractor project team members.

2. CONTINGENCY DEFINITIONS

A. General Contingency

Contingency is an integral part of the total estimated costs of a project. It has been defined as—

> [a] specific provision for unforeseeable elements of cost within the defined project scope. [Contingency is] particularly important where previous experience relating estimates and actual costs has shown that unforeseeable events which will increase costs are likely to occur.

This definition has been adopted by the American Association of Cost Engineers. DOE has elected to narrow the scope of this definition and defines contingency as follows.

> Covers costs that may result from incomplete design, unforeseen and unpredictable conditions, or uncertainties within the defined project scope. The amount of the contingency will depend on the status of design, procurement, and construction; and the complexity and uncertainties of the component parts of the project. Contingency is not to be used to avoid making an accurate assessment of expected cost.

It is not DOE practice to set aside contingency for major schedule changes or unknown design factors, unanticipated regulatory standards or changes, incomplete or additions to project scope definition, force majeure situations, or congressional budget cuts. Project and operations estimates will always contain contingency. Estimators should be aware that contingency is an integral part of the estimate.

B. Buried Contingencies

Some estimators have sought to hide contingency estimates in order to protect the project so that the final project does not go over budget because the contingency has been removed by outside sources. This is affectionately known as buried contingency. All internal and external estimators should refrain from burying extra contingency allowances within the estimate. A culture of honesty should be promoted so that it is not necessary to bury contingency. In addition, estimators should be aware that estimate reviews will identify buried contingency. The estimate reviewer is obligated to remove buried contingency.

3. SPECIFICATIONS FOR CONTINGENCY ANALYSIS

Considerable latitude has been reserved for estimators and managers in the following contingency analysis specifications. These guidelines are to be followed by both the operating contractor and the DOE field office cost estimators to ensure a consistent and standard approach by the project team. Each contractor and field office should incorporate these guidelines into their operating procedures.

A written contingency analysis and estimate will be performed on all cost estimates and maintained in the estimate documentation file. This analysis is mandatory.

Estimators may use the ranges provided in this chapter of the cost guide for estimating small projects; however, larger projects require a more detailed analysis, including a cost estimate basis and a written description for each contingency allowance assigned to the various parts of the estimate.

Justification must be documented in writing when guide ranges for contingency are not followed. If extraordinary conditions exist that call for higher contingencies, the rationale and basis will be documented in the estimate. Computer programs, such as Independent Cost Estimating Contingency Analyzer (ICECAN), a Monte Carlo analysis program, are available to estimators and should be used to develop contingency factors. Risk analysis may also be necessary.

A. Construction Projects

Table 11-1 presents the contingency allowances by type of construction estimate for the seven standard DOE estimate types, and Table 11-2 presents the guidelines for the major components of a construction project.

Estimate types “a” through “e” in Table 11-1 are primarily an indication of the degree of completeness of the design. Type “f,” current working estimates, found in Table 11-2, depends upon the completeness of design, procurement, and construction. Contingency is calculated on the basis of remaining costs not incurred. Type “g,” the Independent Estimate, may occur at any time, and the corresponding contingency would be used (i.e., “a,” “b,” etc.).

Table 11-1. Contingency Allowance Guide By Type of Estimate

Type of Estimate	Overall Contingency Allowances % of Remaining Costs Not Incurred
PLANNING (Prior to CDR) Standard Experimental/Special Conditions	20% to 30% Up to 50%
BUDGET (Based upon CDR) Standard Experimental/Special Conditions	15% to 25% Up to 40%
TITLE I	10% to 20%
TITLE II DESIGN	5% to 15%
GOVERNMENT (BID CHECK)	5% to 15% adjusted to suit market conditions
CURRENT WORKING ESTIMATES	See Table 11-2
INDEPENDENT ESTIMATE	To suit status of project and estimator's judgment

The following factors need to be considered to select the contingency for specific items in the estimate while staying within the guideline ranges for each type of estimate.

1. Project Complexity

Unforeseen, uncertain, and unpredictable conditions will exist. Therefore, using the DOE cost code of accounts for construction, the following percents are provided for planning and budget estimates. They are listed in order of increasing complexity:

- Land and Land Rights 5% to 10%
- Improvements to Land/Standard Equipment 10% to 15%

• New Buildings and Additions, Utilities, Other Structures	15% to 20%
• Engineering	15% to 25%
• Building Modifications	15% to 25%
• Special Facilities (Standard)	20% to 30%
• Experimental/Special Conditions	Up to 50%

Considerations that affect the selection in the ranges are: state-of-the-art design, required reliability, equipment complexity, construction restraints due to continuity of operation, security, contamination, environmental (weather, terrain, location), scheduling, and other items unique to the project, such as nuclear and waste management permits and reviews.

2. Design Completeness or Status

Regardless of the complexity factors listed above, the degree of detailed design to support the estimate is the more important factor. This factor is the major reason that the ranges in Table 11-1 vary from the high of 20 to 30 percent in the planning estimate to 5 to 15 percent at the completion of Title II design. Again, parts of the estimate may have different degrees of design completion, and the appropriate contingency percent must be used. As can be seen from Figure 11-1, as a project progresses, the contingency range and amount of contingency decreases.

3. Market Conditions

Market condition considerations are an addition or a subtraction from the project cost that can be accounted for in contingency. Obviously, the certainty of the estimate prices will have a major impact. The closer to a firm quoted price for equipment or a position of construction work, the less the contingency can be until reaching 1 to 5 percent for the current working type estimate for fixed-price procurement contracts, 3 to 8 percent for fixed-price construction contracts, and 15 to 17.5 percent contingency for cost-plus contracts that have been awarded.

4. Special Conditions

When the technology has not been selected for a project, an optimistic-pessimistic analysis can be completed. For each competing technology, an estimate is made. The difference in these estimates of the optimistic and pessimistic alternative can be used as the contingency.

Table 11-2. Contingency Allowances for Current Working Estimates	
	Item Contingency On Remaining Cost Not Incurred
a. ENGINEERING	
Before Detailed Estimates:	15% to 25%
After Detailed Estimates:	10%
b. EQUIPMENT PROCUREMENT	
Before Bid:	
Budget	15% to 25%
Title I	10% to 20%
Title II	5% to 15%
After Award:	
Cost Plus Award Fee (CPAF) Contract	15%
Fixed-Price Contract	1% to 5%
After Delivery to Site (if no rework)	0%
c. CONSTRUCTION	
Prior to Award:	
Budget	15% to 25%
Title I	10% to 20%
Title II	5% to 15%
After Award:	
CPAF Contract	15% to 17-1/2%
Fixed-Price Contract	3% to 8%
d. TOTAL CONTINGENCY (CALCULATED)	Total of above item contingencies

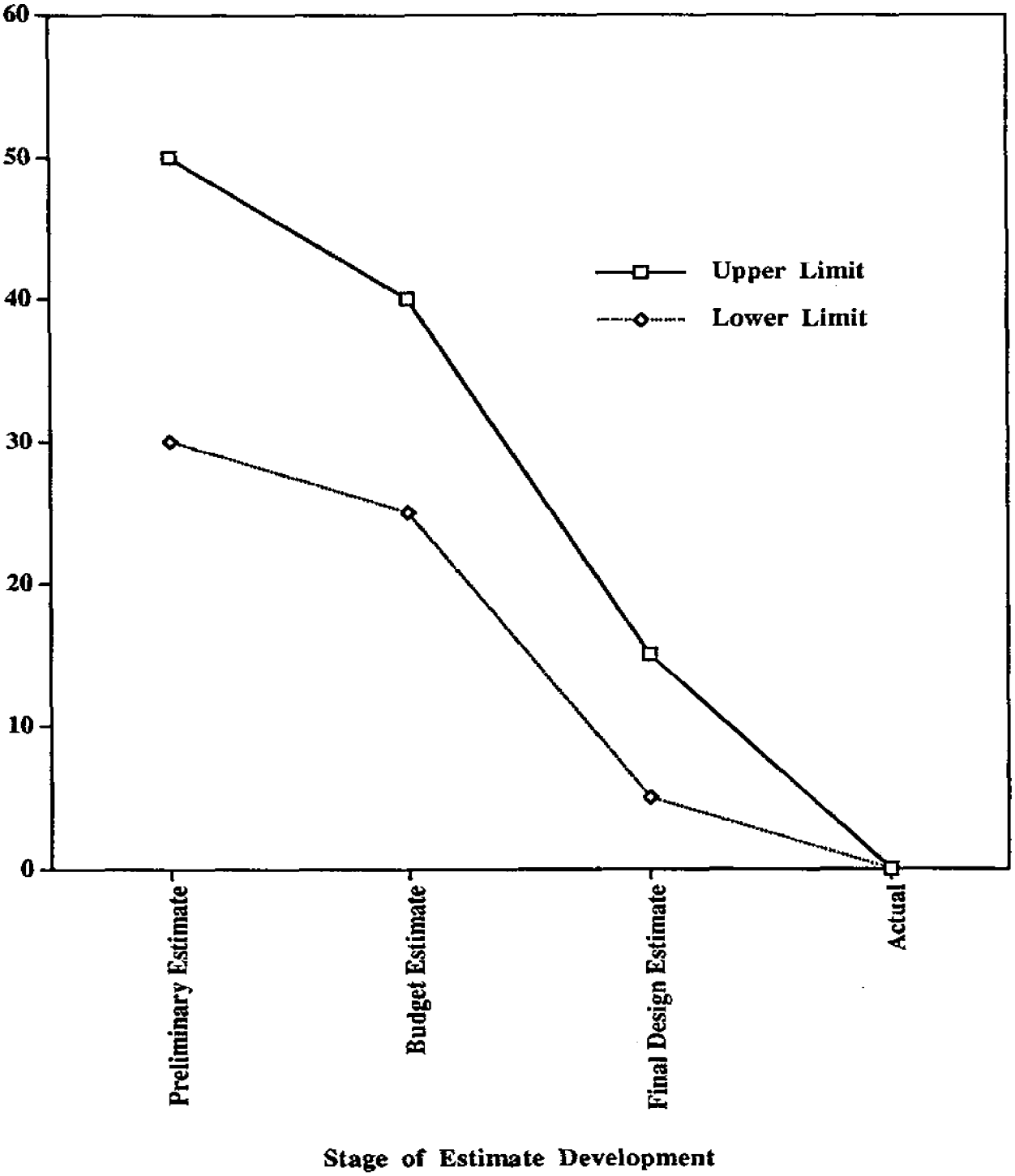

Figure 11-1. Contingency As a Function of Project Life

B. Environmental Restoration Projects

Environmental restoration projects usually consist of an assessment phase and a remediation/cleanup phase. Contingency plays a major role in the cost estimates for both phases. Recommended contingency guidelines for each phase will be discussed below. Table 11-3 lists contingency guidelines for assessment and remediation/cleanup project phases.

1. Assessment Phase

Unlike the remediation phase, the assessment phase does not include the physical construction of a remedy. An assessment determines and evaluates the threat presented by the release and evaluates proposed remedies. As a result, the assessment encompasses such items as field investigations, data analysis, screening and evaluation studies, and the production of reports.

The degree of project definition will depend on how well the scope of the assessment is defined. Higher levels of project definition will correspond to increasing levels of work completed on the assessment. Since the assessment is one of the initial stages of the environmental restoration process, there is a high degree of uncertainty regarding the technical characteristics, legal circumstances, and level of community concern. As a result, the scope of the assessment often evolves into additional operable units, and more than one assessment may be required.

Other considerations that affect the section of contingency ranges are—

- number of alternatives screened and evaluated;
- level and extent of sampling analysis and data evaluation;
- technical and physical characteristics of a site; and
- level of planning required.

Table 11-3 shows the estimate types for the assessment phase of an environmental restoration project and their corresponding expected contingency ranges. No contingency ranges for planning estimates have been provided. The contingencies become smaller as the project progresses and becomes better defined. However, it should be noted that these are only general guidelines based on the level of project definition. A higher or lower contingency may be appropriate depending on the level of project complexity, technical innovation, market innovation, and public acceptance.

Table 11-3. Contingency Guidelines for Environmental Restoration Projects

Activity and Estimate Type	Expected Contingency Range
Preliminary Assessment/Site Investigation Planning Estimate for All Assessment Activities	Up to 100%
Preliminary Estimate for All Assessment Activities	30% to 70%
Remedial Investigation/Feasibility Study Detailed Estimate for All Assessment Activities	15% to 55%
Planning Estimate for All Cleanup Phase Activities	20 to 100%
Contingency Guidelines for Remediation/Cleanup Phase	
Pre-Design Preliminary Estimate for All Remediation/Cleanup Phase Activities	Up to 50%
Remedial Design and Action Detailed Estimate for All Remediation/Cleanup Phase Activities	0% to 25%

2. Remediation/Cleanup Phase

For the remediation/cleanup phase, contingency factors are applied to the remaining design work. Remaining design work will use the same contingency factor as established in the ROD, permit, or current baseline for the project. This contingency percentage will depend upon the degree of uncertainty associated with the project, particularly the degree of uncertainty in the scheduled completion dates.

Table 11-3 shows the estimate types for the remediation/cleanup phase and their corresponding contingency ranges. While the ranges are relatively broad, they reflect the amount of contingency that would have been needed for a set of completed projects. The wide variance accounts for differences in project definition when the estimate was generated, project complexity, technical innovation, and other factors.

Other considerations that affect the section of contingency ranges are:

- innovative technology;
- required reliability;
- equipment complexity;
- construction restraints due to continuity of operation security and contamination;
- environmental conditions (weather, terrain, location, etc.);
- scheduling; and
- other unique items to the project such as waste management permits and reviews.

Prior to the completion of a remedial/corrective measure design estimate, the contingency applied to remaining cleanup work will be no more than that established in the ROD, permit, or current baseline for that project. The percent contingency will depend upon the complexity of the work and the degree of uncertainties involved.

When the construction work is defined by definitive design but the cleanup contract has not yet been awarded, a 15 to 20 percent contingency will be provided on the estimated cost. Usually, the cost estimate is based on detailed drawings and bills of material. When the cleanup work is to be performed by a Cost Plus Award Fee contractor, and the contractor has prepared a detailed estimate of the cleanup cost, and it has been reviewed and approved, a contingency of 15 to 18 percent is applied to only that portion of the cost and commitments remaining to be accrued. On fixed-price cleanup contracts where no significant change orders, modifications, or potential claims are outstanding, a contingency of 3 to 8 percent of the uncompleted portion of the work is provided depending upon the type of work involved and the general status of the contract.

C. Contingency Tools - Monte Carlo Analyses Methodology

Many tools are available to assist estimators with contingency. There is no required tool or program, but Monte Carlo analyses may be performed for all major system acquisitions. Monte Carlo or risk analysis is used when establishing a baseline or baseline change during budget formulation. The contingency developed from the Monte Carlo analyses should fall within the contingency allowance ranges in Table 11-1.

Monte Carlo analyses and other risk assessment techniques use similar methodology to obtain contingency estimates; however, for illustrative purposes, the ICECAN program developed for DOE will be discussed in this section.

The estimator must subdivide the estimate into separate phases or tasks and assess the accuracy of the cost estimate data in each phase. After the project data have been input and checked, the computer program will calculate various contingencies for the overall project based on the probability project underrun. The random number generator accounts for the known estimate accuracy. Once the program has completed its iterations (usually 1000), it produces an overall contingency for the project with a certain accuracy.

The following information is an example project estimate that was input into the ICECAN program.

Base Cost	$1,000,000	Fixed Price
Land Rights	40% $100,000 to $250,000 40% $250,000 to $500,000 20% $500,000 to $600,000	Step-Rectangular Distribution
Labor	50% Less than $100,000 20% $100,000 to $200,000 30% $200,000 to $220,000	Discrete Distribution
Profit	Mean = $235,000 Standard Deviation = $25,000	Normal Distribution

The distribution of the ranges is based on the estimator's judgment. For example, the base cost is a fixed price of $1,000,000 with no anticipated change orders. For landrights, there is a 40 percent chance the cost will be between $100,000 and $250,000, a 40 percent chance the cost will be between $250,000 and $500,000, and a 20 percent chance it will be between $500,000 and $600,000. A step-rectangular distribution was chosen.

The ICECAN program uses the mean cost calculated by the iterations as the base estimate. With the base estimate, there is a 50 percent probability that the project will be underrun. The results in Figure 11-2 show the contingency that should be used to achieve various probabilities overrun. For example, a contingency of 11.1 percent should be used to achieve an 85 percent probability of project underrun. Therefore, the total cost estimate would be $1,901,842. If the worst case cost of each variable had been used, the total estimate would be $2,080,000 or 21.5 percent contingency.

ICECAN

STIMATE FILE: EXAMPLE Contingency Report

Cost Estimate: ***$1,711,863

Probability of Underrun	Contingency Required	Contingency + Estimate
0.50	**********$0 (0.0%)	***$1,711,863
0.55	*********$228 (0.0%)	***$1,712,091
0.60	******$33,137 (1.9%)	***$1,745,000
0.65	******$76,269 (4.5%)	***$1,788,132
0.70	*****$111,558 (6.5%)	***$1,823,421
0.75	*****$140,282 (8.2%)	***$1,852,145
0.80	*****$163,372 (9.5%)	***$1,875,235
0.85	*****$189,979 (11.1%)	***$1,901,842
0.90	*****$224,928 (13.1%)	***$1,936,791
0.91	*****$235,725 (13.8%)	***$1,947,588
0.92	*****$248,795 (14.5%)	***$1,960,658
0.93	*****$257,706 (15.1%)	***$1,969,569
0.94	*****$266,618 (15.6%)	***$1,978,481
0.95	*****$278,856 (16.3%)	***$1,990,719
0.96	*****$292,907 (17.1%)	***$2,004,770
0.97	*****$308,836 (18.0%)	***$2,020,699
0.98	*****$321,089 (18.8%)	***$2,032,952
0.99	*****$343,554 (20.1%)	***$2,055,417
1.00	*****$366,427 (21.4%)	***$2,078,290

Figure 11-2. Contingency Data Results

Operations and Maintenance: (formerly Operating Expense or Waste Management category)

Laboratory Operation and Maintenance: Equipment Replacement, System Maintenance, HEPA Maintenance, Equipment Maintenance

Production Operation and Maintenance: Chemical Processing, Vitrification Operations, Waste Management, Manufacturing

Other Operation and Maintenance: Maintenance Work, Roof Replacement, Building Systems, Landlord Activities, Hotel Load Maintenance.

Research and Development: (Formerly Energy Research and Nuclear, Fossil, Conservation and Solar Categories)

Research and Development: Fossil Energy, Energy Research, Solar Energy, Alternative Energy Sources

Applied Science: Medical, Basic Science

Nuclear Research: Weapons Production, Security Infrastructure, Weapons Simulation, Nuclear Energy

CHAPTER 25

GUIDELINES FOR ENGINEERING, DESIGN, AND INSPECTION COSTS

1. INTRODUCTION

Engineering, design, and inspection (ED&I) activities begin with the preliminary design (Title I). Pre-Title I activities are not considered part of ED&I activities. ED&I activities include the engineering and design activities in Title I & II and the inspection activities associated with Title III. A more detailed description of the Title I, II, and III activities can be found in Chapter 3 of this volume.

Architectural/Engineering (A/E) activities are part of the ED&I activities. A/E activities are services that are an integral part of the production and delivery of the design plans, specifications, and drawings. Federal statutes limit the A/E costs to a percent of total construction cost, and these statutes have specific definitions of what activities are included in A/E costs. Activities that are not an integral part of the production of the design plans, specifications, or drawings may still be ED&I activities but are not A/E activities.

This chapter defines ED&I and A/E activities and discusses how to estimate and track them.

2. ED&I ACTIVITIES

To estimate ED&I costs, the estimator must understand what activities are included in ED&I.

Following is a list of ED&I activities:

- Preliminary and final design calculations and analyses
- Preliminary and definitive plans and drawings
- Outline specifications
- Construction cost estimates
- Computer-aided Drafting (CAD) and computer services
- A/E internal design coordination
- Design cost and schedule analyses and control
- Design progress reporting

- Regulatory/code overview by A/E
- Procurement and construction specifications
- Surveys (surveying), topographic services, core borings, soil analyses, etc., to support design
- Travel to support design
- Reproduction during design
- Design kickoff meeting
- Constructability reviews
- Safety reviews by A/E
- Value engineering
- Identification of long lead procurements
- Design studies not included in Pre-Title I
- Preliminary safety analysis report if not included in the Conceptual Design Report
- Design change control
- Modification of existing safety analysis report
- Design reviews (not third party)
- Acceptance procedures
- Certified engineering reports
- Bid package preparation
- Bid evaluation/opening/award
- Inspection planning
- Inspection services
- Review shop drawings
- Preparation of as-built drawings

3. WAYS TO ESTIMATE ENGINEERING, DESIGN, AND INSPECTION COSTS

Different methods may be used to estimate ED&I costs. Some common methods are: count drawings and specifications, full time equivalents (FTEs), and percentage.

A. Count Drawings and Specifications Method

When using this method, the estimator calculates the number of drawings and specifications representing a specific project. The more complex a project is, the more drawings and specifications it will require, and, therefore, more ED&I Costs will be associated with it.

B. Full Time Equivalent Method

The FTE method utilizes the number of individuals that are anticipated to perform the ED&I functions of a project. The manhour quantity is calculated and multiplied by the cost per labor hour and the duration of the project to arrive at the cost.

C. Percentage Method

When using this method, the estimator simply calculates a certain percentage of the direct costs and assigns this amount to ED&I. Federal statutes limit the A/E portions of ED&I costs to 6 percent of construction costs. Total ED&I percentages are usually from 15 to 25 percent.

D. Documenting Engineering, Design, and Inspection Costs

DOE Headquarters developed the A/E Cost Standard Form as a tool to be used for estimating and compiling actual costs on all conventional construction projects and the conventional portions of nonconventional projects. The DOE ad hoc working group refined a U. S. Navy form to develop this standard for estimating A/E services. The form, definitions, and instructions for the A/E Cost Standard Form have been published and distributed and are included as Attachment 25-1 to this chapter. The following conditions apply to the use of the cost standard or form.

1. All conventional line-item construction projects will use the standard. General plant projects are excluded.

2. Conventional construction projects include such things as warehouses, laboratories, office buildings, non-process related utilities, sewage and water treatment facilities, parking lots, roof repair, roads, etc. Conventional construction does not mean the projects are necessarily simple, nonsophisticated, or standard, but that simply from a design point of view, prior industry experience exists. Nonconventional projects include projects that are first of a kind and the level of effort is not easily predictable.

3. In calculating the design/construction cost percentage ratio, equipment, equipment installation, and other nonconstruction costs will be excluded from the construction cost estimate. Therefore, construction costs included in the calculation will be limited to those construction items for which the A/E contractor has design responsibility. This method is used for determining contract performance. Additional costs for other design, drawings, and specifications (either in-house or outside source) will be documented and included in the total design/construction cost ratio, thereby measuring project performance.

4. The cost standard will be used in the construction of budget estimates and all subsequent estimates and in the management of the cost baselines.

5. A/E contracts will be structured in accordance with the cost standard to segregate design, drawings, and specification costs from the other A/E costs, so that tracking and analyzing actual costs can be accomplished by categories.

6. Any site overhead allocated to construction projects will be identified and documented separately from all other components of project costs so that DOE cost analyses will be comparable to those of other Federal agencies and commercial organizations.

7. The cost standard should be used on all new projects. Project managers will not be required to restructure already completed projects into the format. However, they are encouraged to restructure cost data on completed projects whose cost components are organized in a manner similar to the cost standard format.

8. The A/E Cost Standard Form was designed to provide a standard format for developing cost estimates, structuring contractor proposals, and tracking the cost performance of A/E contracts and other A/E activities. Federal statutes limit A/E cost to 6 percent of construction costs. The A/E services provided under this statute are design, drawings, and specifications. While it is our intention to minimize all A/E costs, it is our goal to keep these specific costs within the 6 percent limit. By collecting costs in this format, the Department can compare its cost performance to other agencies on a comparable basis. Therefore, field offices should ensure that all cost estimates, actual cost data collected during design and construction, and all A/E contracts are segregated to show both total ED&I costs and the subcomponents of design, drawings, and specifications. Also, each site should maintain adequate documentation on actual design and construction costs to facilitate local analysis on the site's overall performance.

   Field Office managers and individual project managers are responsible for ensuring that cost estimates, contracts, and cost management of A/E services are structured according to the above standard. Subsequent historical cost data will be used for project analysis and to support local cost databases. These data should help assess contractor performance, improve future cost estimates, and generate recommendations for reducing the A/E costs, on a site-wide basis.

   With A/E costs or activities being defined, data can be gathered on a more comparable basis. This will allow for easier evaluation, as well as support for the development of local cost databases for A/E costs.

E. Considerations When Estimating

ED&I costs are directly related to the magnitude and complexity of the project. The following items should be considered.

1. Comprehensiveness of the Functional/Operational Requirements

Project understanding is improved when comprehensive functional/operational (F/O) requirements are provided. For the F/O requirements to be well done, each item must be thought through by those who review the design and will use, operate, and maintain the facility or system.

2. Quality Level

Quality level, as defined below, is significant particularly as it affects the analysis, documentation, and inspection required. Design costs are increased by the additional work that may be required by the following levels.

a. Quality Level I

Applied to nuclear system, structure, subsystem, item, component, or design characteristics that prevent or mitigate the consequences of postulated accidents that could cause undue risks to the health and safety of the public.

b. Quality Level II

Any other system, structure, subsystem, item, or component that as a result of failure could cause degradation of required performance, such as plant operation, test results, and performance data.

c. Quality Level III

Items designated for minimal impact applications.

3. Design Planning Tabulation

Design Planning Tabulation (DPT) sets forth a number of important items that affect ED&I costs. The DPT sets the code requirements the design will meet, reviews to be held, quality levels, and documents to be issued.

4. Design Layout

Design layout costs are affected by the availability of existing documents and the accuracy of these documents. The need for an engineer to make detailed layouts rather than having it done by draftsmen/designers also affects cost.

5. Engineering Calculations

The amount and detail of calculations required is an important engineering cost factor. The need for review of these calculations by others and their documentation and storage can affect ED&I cost significantly.

6. Drafting

The drawing format and the method of accomplishment of the work depicted (i.e., by maintenance, lump sum construction contract, or cost plus construction contract) will affect the detail and time required to prepare drawing(s). The type of drawing and the discipline of work are also big factors in time required. The number of drawings involved is a direct indication of drafting time and cost. The availability of standard details, etc., can reduce costs appreciably. Quality Level I or II requirements can also add to drafting requirements and thus time.

7. Specification Preparation

The availability of draft specifications for the items of work involved or the need to develop new specifications must be considered. Projects requiring preliminary proposals require both an outline specification, which is normally prepared with Title I, and a detailed technical specification. Performance specifications for both the design and installation by a subcontractor of facilities and systems, such as fire protection, will reduce engineering costs. Design costs incurred by the subcontractor are classified as subcontract construction costs.

8. Checking

The need for field investigation can be a significant engineering cost. If drafting must be checked by checkers within that section, the time must be considered and costs added. Projects requiring inter-discipline checks must have time/cost provisions. Checks made by engineers must also be considered.

9. Cost Estimating

Time required for estimating is affected by the detail of the project, particularly the number of items involved and the areas in which good information from historical data or test hooks on cost are available. Specialty items usually require additional effort and cost.

10. Design Reviews

The number of design reviews and action taken will affect costs. If the design is so formal that a committee is established for the review and the designers

must present their designs step by step, the additional costs required for review must be included.

11. Safety Analysis Report

When a Safety Analysis Report (SAR) is required, the engineering costs are contingent upon similar documents having been prepared previously or the requirements to develop new ones.

12. Reports

Engineering costs for preparing reports such as preliminary proposals, design status reports, etc., must be included in the ED&I funds.

13. Government Furnished Equipment

Engineering costs for providing documents required for procuring Government Furnished Equipment (GFE) items must be included. These costs include specifications. Time required for engineering is more than if the item had been included with the other technical documents due to document control and the need to include in the technical documents information on the item being furnished.

14. Off-Site A/E

If an off-site A/E is to be used for the design, travel costs for field investigation, design reviews, and management of the design should be considered. Cost is a percentage of construction cost. If changes are required, onsite A/E may have to make the changes, which could lead to problems in interpreting or understanding the basis of the original design.

15. Inspection

Included as part of Title III, all construction work, including procurement and installation of associated equipment, shall be conducted in all cases prior to acceptance. Inspection should be made at such times and places as may be necessary to provide the degree of assurance required to determine that the materials or services comply with contract and specification requirements, including quality level requirements. The type and extent of inspection needed will depend on the nature, value, and functional importance of the project and its component parts, as determined by project requester/proposer. Specifically, the following should be considered.

16. Duration

Duration is the number of actual construction days anticipated for the project. Unforeseen conditions, such as delays in start-up and waiting for materials, are not included in this duration.

17. Labor Density

Labor density is the ratio of estimated costs of materials to costs of labor. In general, construction with a high labor density will require more inspection.

18. Complexity

A project having a high degree of instrumentation of a large amount of "code equivalent" welding will require more inspection per dollar of labor than will earth work or ordinary concrete work.

19. Overtime

The time schedule of utility outages, reactor windows, and the overall project schedule may require overtime.

20. Adequacy of Plans and Specifications

If the technical package is clear, with a minimum of ambiguities, and will require few field changes, the inspection cost will be lower.

21. Offsite Fabrications

Inspection costs will increase if source inspections are required. Supplies and services shall be inspected at the source where:

a. inspection at any other point would require uneconomical disassembly or nondestructive testing;

b. considerable loss would result from the manufacture and shipment of unacceptable supplies or from the delay in making necessary corrections;

c. special instruments, gauges, or facilities required for inspection are available only at source;

d. inspection at any other point would destroy or require the replacement of costly special packing and packaging;

e. a quality control system is required by the contract, or inspection during performance of the contract is essential;

f. it is otherwise determined to be in the best interest of the Government.

22. Location of the Job

Travel time to and from the job must be taken into consideration.

23. Guideline

ED&I costs have been between 15 percent and 26 percent of the total construction cost for detailed design.

24. Performance Specification

This type of specification requires the subcontractor to supply the amount of detail required to complete the project. The amount of ED&I required for a performance specification is appreciably less than that required for the detailed design.

F. Engineering

Although these services may seem similar to conventional engineering, design, and inspection, there are several important differences that distinguish cleanup design from engineering design on other projects. These differences need to be underscored when estimating cost and schedule requirements. Major factors to be considered by the estimator include the following.

1. The regulatory process requires rigorous examination of design alternatives prior to the start of cleanup design. This occurs during remedial investigation/feasibility studies under CERCLA to support a record of decision (ROD) or during corrective measure studies under RCRA to support issuance of a permit. Cleanup design executes a design based on the method identified in the ROD or permit. This often narrows the scope of preliminary design and reduces the cost and schedule requirements. The estimator needs to assess the extent to which design development is required or allowed in cleanup design. In some cases, the ROD or permit will be very specific as in the case of a disposal facility where all features, such as liner systems, as well as configuration, are fixed. In other cases, such as when treatment options like incineration are recommended, considerable design effort may be required.

2. Requirements for engineering during construction including, construction observation, design of temporary facilities, quality control, testing, and documentation, will often be higher than for conventional construction. This results from the need to conduct construction activities for environmental projects in compliance with rigid regulations governing health and safety, quality assurance, and other project requirements.

CHAPTER 25

ATTACHMENT 25-1

A/E COST STANDARD FORM USAGE GUIDANCE

The Architect/Engineer (A/E) Cost Standard Form was designed to provide a standard format for the collection of A/E costs. Federal statutes limit the A/E costs to a percent of total construction cost, and these statutes have specific definitions of what is included in A/E costs. By collecting costs in the format of this form, the Department will be consistent with the definition of A/E costs used by other Federal agencies and will be able to determine what is being spent on A/E costs on a uniform basis throughout the Department.

The form, attached, is divided into three sections:

- Section A - Design
- Section B - Title III Services
- Section C - Engineering Services

Some departments may use different names for some of the functions described in the form. If this is the case, a crosswalk sheet can be developed and used to aid in converting the terms used locally to fit those in this form. If necessary, items can be added to each section. Sheets should be attached to completely define any items added. Minimal additions or changes are anticipated in Sections A and B, while Section C will more commonly have additions.

This form is used to collect Engineering, design, and inspection (ED&I) costs according to DOE Order 2200.6. Pre-Title I activities are not a part of ED&I. Pre-Title I activities include surveys, topographical services, core borings, soil analysis, etc., that are necessary to support design. These activities are charged to operating costs. Other costs that, according to DOE Order 2200.6, are not part of operating costs, include project management, the maintenance and operation of scheduling, estimating, and project control systems during design and construction, and the preparation, revision, and related activity involved in producing the final safety analysis report.

The attached “A/E Cost Standard Form - Engineering and Design Activities” table lists the Title I, Title II, and Title III activities and groups them in Sections A, B, or C as they appear on the A/E Cost Standard Form

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Page 2

The following will discuss each section individually.

Section A - Design

Section A includes the Title I and Title II costs directly related to developing the design drawings and specifications necessary for the project. Note that Section A includes only the cost of labor hours that are necessary to perform this design work. If, because of project requirements, other disciplines are required, they can be added. Note that other Title I and Title II costs can be covered in Section C.

Section B - Title III Services

Section B includes the costs for reviewing shop drawing submittals, inspection services, and the preparation of as-built drawings.

Section C - Engineering Services

Section C includes the support services required during the Title I, Title II, and Title III project work. This includes such activities as the energy conservation study, cost engineering, value engineering services, travel, computer equipment costs, etc. Note that the Computer Aided Drafting (CAD) operator's time is included in Section A. Note also that some of the activities in Section C, such as travel and per diem, can occur in Title I, Title II, and Title III work.

Design Schedule

The design schedule should be filled out in the bottom left-hand portion of the form under Section C. The cost summary is filled out to the right of the design schedule and includes the costs of Sections A, B, and C, which are added together to generate a total ED&I cost.

A/E COST STANDARD

DOE Architect-Engineer
Cost Standard Form

A/E Firm Name:	Consultant's Name(s):	A/E Contract No:	
Project Title:		DE No:	Field Office:
Location:		Est.Const.Cost:	

		Engineering Discipline	Est. No. Dwgs.	Hourly Rate	Title I			Title II			Total Design	
					Est. Hrs.	Estimated Cost		Est. Hrs.	Estimated Cost		Est. Hrs.	Estimated Cost
						A/E	Consul-tant		A/E	Consul-tant		
SECTION A DESIGN	DRAWINGS	Project Engineer										
		Architect										
		Stru Engineer										
		Mech Engineer										
		Elec Engineer										
		Civil Engineer										
		Fire Engineer										
		Coordination QC										
		Arch Draftsman										
		Stru Draftsman										
		Mech Draftsman										
		Elec Draftsman										
		Civil Draftsman										
		Fire Draftsman										
		Total Drawings										
	SPECS	Spec Writer										
		Typist										
		Total Specifications										
		Total Est. Cost A/E & Consultant										
		Overhead A/E ____ Consult. ____ %										
		Subtotal										
		Profit ____ %										
		Subtotal										
		Total cost of section A (Design)				$ ____ sheet			% of ECC ____ %			

COMPUTE COST PER SHEET AND DESIGN PERCENTAGE OF ESTIMATED CONSTRUCTION COST

ENGINEERING SERVICES SUMMARY SHEET (PROVIDE BACK-UP FOR EACH ITEM)		TITLE I	TITLE II	TITLE III	TOTAL
Section B Title III Services	Review of Shop Drawing Submittals				
	Inspection Services				
	Prepare As-Built Drawings				
	Total Cost of Section B				
SECTION C ENGINEERING SERVICES	Inspection Planning				
	Design QA Plan				
	Reproduction During Design				
	Constructability Reviews				
	Certified Engineering Reports				
	Design Studies Not Included in Pre-Title I				
	Project Schedules				
	Cost Engineering				
	Value Engineering Services				
	Travel to Support Design				
	Other (Specify)				
	Total Cost of Section C				

DESIGN SCHEDULE		COST SUMMARY				
	30% Submit/Rev = ____ wks		Total Section A (Design)				
	60% Submit/Rev = ____ wks		Total Section B (Title III)				
	90% Submit/Rev = ____ wks		Total Section C (Engr Serv)				
	Final Submit /Rev = ____ wks		GRAND TOTAL - Fee Proposal				
	TOTAL = _____ wks						
SIGNATURE			APPROVAL			DATE	

A/E COST STANDARD FORM
ENGINEERING AND DESIGN ACTIVITIES

	TITLE I ACTIVITIES	TITLE II ACTIVITIES	TITLE III ACTIVITIES
S	Preliminary Design Calculations and Analyses	Final Design Calculations and Analyses	
E	Preliminary Drawings	Definitive Drawings	
C	Preliminary Plans	Definitive Plans	
T	Outline Specifications	Procurement and Construction Specs	
I	CAD and Computer Services (operators)	CAD and Computer Services (operators)	
O	A/E Internal Design Coordination	A/E Internal Design Coordination	
N	Design Cost and Schedule Analysis and Control	Design Cost and Schedule Analysis and Control	
	Design Progress Reporting	Design Progress Reporting	
A	Regulatory/Code Overview by A/E		
S	Design QA Plan and Overview	Travel to Support Design	Inspection Services
E	Travel to Support Design	Reproduction During Design	Review Shop Drawings
C	Reproduction During Design	Designs Reviews, QA, and Overview (not Third Party)	Prepare As-Built Drawings
T	CAD and Computer Services (support)	CAD and computer Services (support)	
I	Project Schedules	Project Schedules	
O	Construction Cost Estimates	Constructability Reviews	
N	Constructability Reviews	Safety Reviews by A/E	
S	Safety Reviews by A/E	Construction Cost Estimates	
	Value Engineering	Acceptance Procedures	
B	Identify Long Lead Procurements	Certified Engineering Reports	
	Design Studies Not Included in Pre-Title I	Bid Package Preparation	
and	Preliminary Safety Analysis Report if Not Included in the CDR		
	Design Change Control	Design Change Control	
C		Inspection Planning	

Note: This representative list of functions was developed from FAR and DOE definitions.
All functions meet FAR criteria, and the categories are segregated according to the FAR.

FY 2003 RATE SHEET

Indirect | Fringe | OPTO | Vacation | Chargeback

INDIRECT RATES

	ACTUAL	EFFECTIVE
MSA	5.5%	16.1%
CSS	18.5%	30.4%
G&A	10.0%	10.0%
PASS THROUGH	1.5%	1.5%

FRINGE RATES

FRINGE	30.0%	30.0%
SUMMER STUDENT FRINGE	8.0%	8.0%

VACATION/OPTO RATES

	WEEKLY	MONTHLY
VACATION ACCRUAL	11.0%	11.0%

OTHER PAID TIME OFF (OPTO)	**9.0%**	**6.5%**

CHARGEBACK RATES

MACHINE SHOP CHARGE BACK RATE	**$55.00**
FESS ENGINEERING CHARGE BACK RATE	**$71.00**

Fermilab
ESH Section

Multi-Organization Construction Site Safety Walkthrough

1.0 Background and Purpose

Background: The vast majority of incidents happen when barriers are bypassed, procedures are not followed or there are departures by workers from safe behaviors. Unsafe conditions have historically been a small percentage of the causes of accidents whereas behaviors or unsafe acts are the bulk of the causes. In order to eliminate these incidents from the workplace we must concentrate our efforts to those actions that will have the biggest return on "investment" such as the elimination of unsafe behaviors and the evaluation of work processes and barriers to determine conformance with accepted practices.

Purpose: To establish a process for conducting formal safety program evaluations and field assessments through site safety walkthroughs for construction activities. These walk-throughs should consider management systems, employee behaviors, conformance to the subcontractor safety plan, and performance to Fermilab requirements as expressed in contractual documents, pre-bid and pre-construction meetings.

2.0 Scope

This procedure applies to all active construction activities that require a multi-organizational scrutiny as designated by the Associate Director for Operations.

3.0 Responsibilities

3.1 Construction Manager

3.1.1 Determine the frequency of walkthroughs based upon input received from the Associate Director for Operations and the Project Manager. Frequency should be identified in the Project Execution Plan (PEP).

3.1.2 Identify walk-through team members. The team should be kept to a reasonable size and may include the Construction Manager, Construction Coordinator, Subcontractor Superintendent, a representative from the Fermilab ESH Section, a representative from the Department of Energy Fermi Area Office if requested, and a Project ESH Coordinator, if one is assigned.

3.1.3 Conduct a closeout meeting as described below.

3.2 Construction Coordinator

3.2.1 Assist the Construction Manager in the walkthrough process as requested. Such requests may include:

3.2.1.1 Transmit all concerns to the Sub-Contractor for resolution and provide copies to all team members.

3.2.1.2 Review corrective action responses from the Sub-Contractor and provide feedback to the Construction Manager and the Project ES&H Coordinator.

3.2.1.3 Track responses to action items (in a formal database, daily/weekly logs or construction meeting minutes).

3.2.1.4 Document & distribute closeout-meeting minutes.

3.3 ES&H Section Representative

3.3.1 Provide technical support relative to safety issues.

3.4 Project ES&H Coordinator

3.4.1 Participate in walkthroughs keeping an eye especially toward safety issues that would impact installation and operational activities that will follow construction.

3.4.2 Provide feedback from walkthroughs and closeout meetings directly to the Project Manager.

4.0 Procedure

4.1 The Construction Manager (CM) will identify the time and frequency of the walkthrough.

4.2 The CM will develop an agenda for the walk-through and identify any specific areas to focus on. Appendix A should be used as guidance. Trying to cover a broad spectrum of programs or activities may result in specifics being missed. This is especially true for a larger project, or one covering more than one work site. Interviews with subcontractor employees are encouraged.

Field observations from one visit may give rise to focused assessments at a future date or provide justification for a formal audit.

4.3 CM will complete a closeout meeting with all participating organizations to discuss results of the walkthrough and to discuss suggestions for possible corrective actions.

4.4 Document walkthrough results through meeting minutes that will be distributed to all participating organizations.

4.5 Enter concerns and corrective actions into a database created for the specific project.

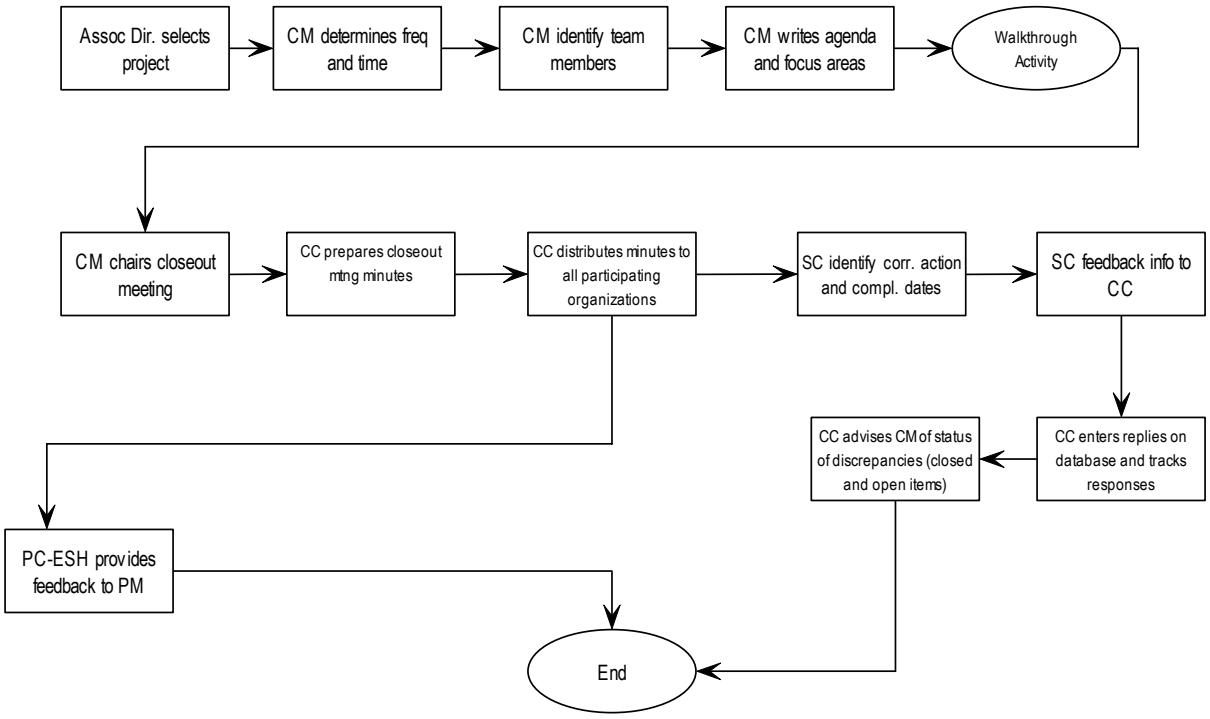
5.0 Corrective Actions

5.1 The walkthrough report shall be provided to the subcontractor for action.

5.2 The subcontractor shall identify corrective actions and completion dates. Corrective actions shall be completed as quickly as possible.

Flow Diagram

Construction Project
Multi-Organizational Safety Walkthrough



Abbreviations:

ADO	Associate Director for Operations
CM	Construction Manager
CC	Construction Coordinator
PC-ESH	Project ES&H Coordinator
PM	Project Manager

Appendix

ESH Assessment Guidance- Areas of Inquiry

1. Injuries or Illnesses

2. General
   - Housekeeping
   - Garbage Containers
   - Emergency Phone #s Posted
   - Emergency Communication
   - Fence Condition
   - Gates
   - Signage on Fences and Gates
   - Whip Checks
   - Electrical Cords
   - GFCI's
   - Gas Test Log
   - Machine/Equipment Guards
   - Lighting
   - Ladders
   - Explosive Storage
   - Oxy/Acetylene Storage
   - Scaffolding

2. Traffic Control
   - Barricades
   - Traffic Signs
   - Flag Person
   - Vests
   - Flag

3. Shafts & Tunnels
   - Hand held lights/Miners Lights
   - Lighting
   - Communication
   - Ventilation
   - Self Rescuers Present

- Housekeeping
- Air/Noise Testing
- Signage
- Barricades

4. Emergency Equipment
   - Fire Extinguishers
   - First Aid Kits
   - Oxygen
   - Blankets
   - Eye Wash
   - Infection Control
   - Medical Emergency Teams
   - Rescue Teams

5. Personal Protective Equipment
   - Hard Hats
   - Eye Protection
   - Hearing Protection
   - Foot Protection
   - Respiratory Protection
   - Hand Protection
   - Fall Protection Harness/Lanyard
   - Face Protection
   - Barrier Cream

6. Cranes
   - Inspections
   - Certifications
   - Anti-Two Blocks
   - Hook Latches
   - Perimeter Barricades
   - Glass
   - Horn
   - Fire Extinguisher
   - Rigging Equipment

7. Equipment
   - Daily Inspections
   - Glass

- Back-Up Alarm
- Fire Extinguishers
- Hydraulic Oil Leaks

8. Work Planning
    - H/A for Tasks Performed
    - Dail Huddles
    - Tool Box Meetings
    - Monthly ESH Meetings
    - Records/Log Reviews
    - LOTO